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CS84-BMDSC-0018

(NASA-CR-171814) HISTORY OF ON-ORBIT
SATELLITE FRAGMENTATIONS (Teledyne Brown
Engineering) 344 p HC A15/MF A01 CSCL 22B

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HISTORY OF ON-ORBIT SATELLITE FRAGMENTATIONS

August 1984



Prepared for
Ballistic Missile Defense Systems Command
Huntsville, Alabama 35807

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TELEDYNE
BROWN ENGINEERING

1250 Academy Park Loop, Suite 240
Colorado Springs, Colorado 80910

Technical Report

History of On-Orbit Satellite Fragmentations

by

N. L. Johnson
J. R. Gabbard
G. T. DeVere
E. E. Johnson

August 1984

Prepared for

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Contract No. DASC60-84-C-0005
CDRL Item A029

Prepared By

Teledyne Brown Engineering
Colorado Springs, Colorado 80910

INTRODUCTION

The phenomenon of on-orbit satellite fragmentation was first observed in June 1961 when the Transit 4A rocket body disintegrated into 261 detectable pieces of debris. Since that time there have been more than eighty similar events from 75 parent satellites accounting for over 5,200 cataloged pieces of debris. Today approximately 50% of all the objects currently being tracked by the NORAD Spacetrack Network originated from on-orbit fragmentations.

The causes of on-orbit fragmentations are varied and may be intentional or accidental. For example, a satellite may be deliberately destroyed by an explosive charge as part of a spacecraft test or a rocket stage may suffer a catastrophic propulsion failure. Unfortunately, the cause of many fragmentations remains unknown. While a few cases are currently under investigation as on-orbit collision candidates, man is directly responsible for the vast majority of artificial debris polluting the near-Earth space environment.

The magnitude of each fragmentation (i.e. the number of liberated pieces observed) may also vary substantially. Low altitude rocket stage explosions may result in hundreds of short-lived pieces of debris whereas only a few pieces may be observed in conjunction with much higher fragmented objects. It should be emphasized that the number of fragments listed with each event in this document represent only those debris officially cataloged by NORAD. At low altitude fragmentations many pieces are not cataloged as a result of their high drag rates and quick reentries. For example, although only 31 fragments were cataloged from the break-up of 1982-88A, at least 138 objects were detected by one NORAD radar shortly after the event. Likewise many small objects are believed to be orbiting at higher altitudes as the result of fragmentations above 600 km but are undetectable with the current SPACETRACK network. Finally, some spacecraft


ject several or tens of objects during their normal operational duties; however, these events do not qualify as fragmentations as defined in this document.

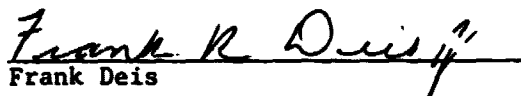
The data compiled in this document originated from several sources: NORAD archives, the Naval Space Surveillance System (NAVSPASUR), the Royal Aircraft Establishment, miscellaneous reports, and in-house technical analyses. Special thanks for their cooperation and guidance are extended to Mr. Preston Landry (Space Command, XPYS) and Mr. D. G. King-Hele (Royal Aircraft Establishment). Whenever possible, the data have been cross-checked. For instance, when a break-up time and location were provided by NAVSPASUR, satellite element sets and fragment distribution curves (Gabbard diagrams) were examined to verify the feasibility of this information. In this way many data base errors were discovered and corrected. Complete information is not available on all events due to the absence of archival data. Indeed documentation of some events is sparse or virtually nonexistent.

Each known on-orbit satellite fragmentation is described within this document in module format. The first page is headed by the satellite's international designator, common name, and NORAD Space Surveillance Center (NSSC) control number. Also listed on this page will be pertinent characteristics of each fragmentation event. Page two of each module will contain comments regarding the nature of the satellite and additional details of the event(s) as well as the probable cause of the event. The remaining pages of each module contain plots of debris distributions on Gabbard diagrams and maps indicating the event orbit groundtrack and location of the satellite at the time of the events. The two large symbols on each Gabbard diagram indicate the apogee and perigee of the parent satellite. The reader is cautioned that all orbital parameters on the Gabbard diagrams are not referenced to a single epoch. In some cases when fragment element sets were developed several days or weeks after the event, the effects of atmospheric drag can be observed. Where the precise location of the event is known a satellite symbol on the orbit trace marks this position. In other cases,

only the orbit(s) on which the event probably occurred are provided.

This work was sponsored by the NASA Johnson Space Center with cooperation of USAF Space Command and the U.S. Army Ballistic Missile Command under Contract Number DASG60-84-C-0005.

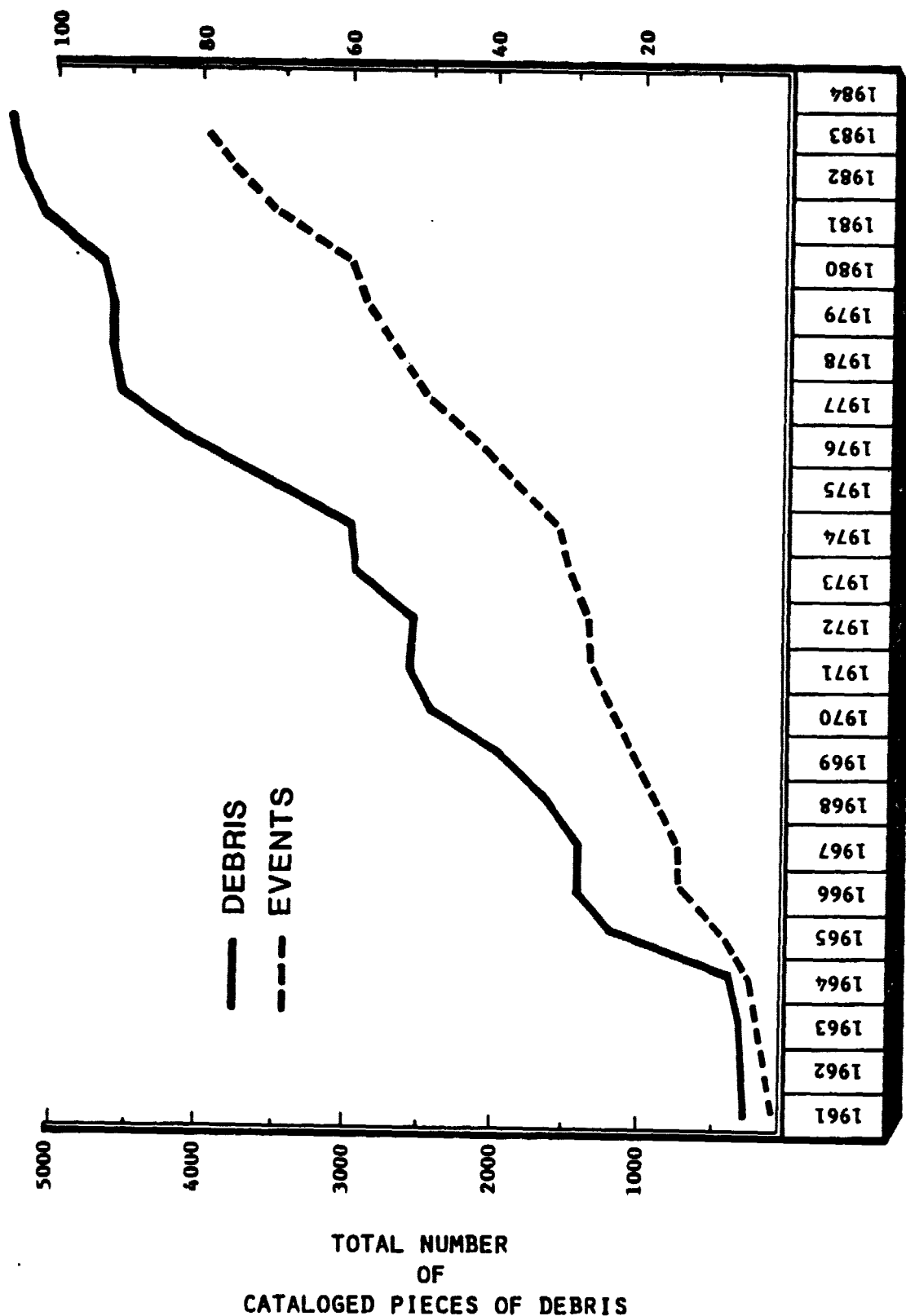

Nicholas L. Johnson
Principal Technologist


Frank Deis
Technical Director
Colorado Springs Office

HISTORY OF ON-ORBIT FRAGMENTATIONS

TOTAL NUMBER
OF
FRAGMENTATION EVENTS

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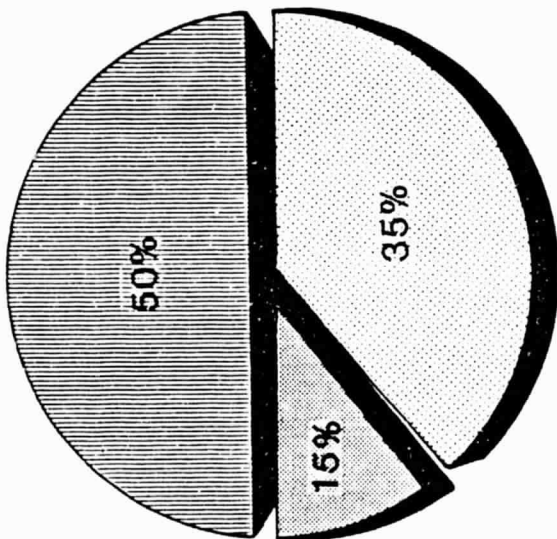


AS OF 1 JANUARY 1984

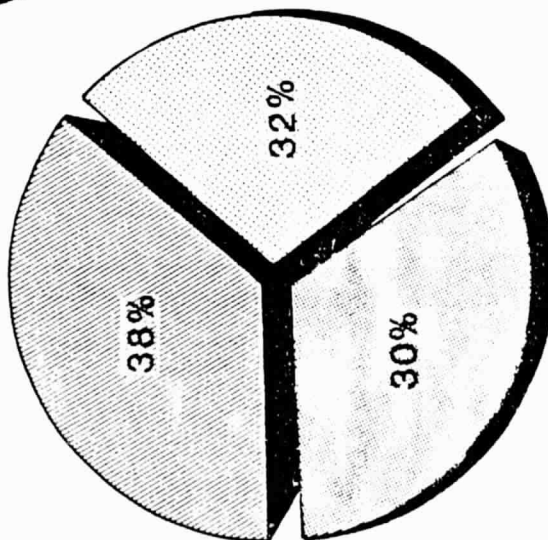
CAUSES OF ON-ORBIT FRAGMENTATIONS AND DEBRIS

ORIGINAL PHOTOGRAPH
OF POSTER

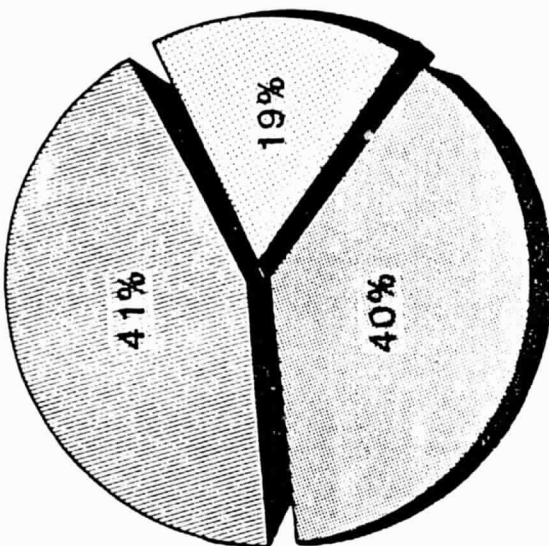
• CAUSES



• DEBRIS CREATED



• DEBRIS IN ORBIT



UNKNOWN
DELIBERATE
PROPULSION-RELATED

TELEDYNE
BROWN ENGINEERING
1250 ACADEMY PARK LOOP
COLORADO SPRINGS, COLORADO 80910

(AS OF 1 JANUARY 1984)

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Section I

Satellite Fragmentations

1961-Omicron

TRANSIT 4A ROCKET

116

LAUNCH DATE: 29.18 Jun 1961

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 29 Jun 1961 (DAY 180)

TIME: 062810.0 GMT

LOCATION: 28N, 254E

ALTITUDE: 950 KM

PIECES CATALOGED (1 JAN 84): 261

PIECES STILL IN ORBIT (1 JAN 84): 199

ORBIT CHARACTERISTICS:

INCLINATION: 66.81°

APOGEE: 998 km

PERIGEE: 880 km

PERIOD: 103.8 min

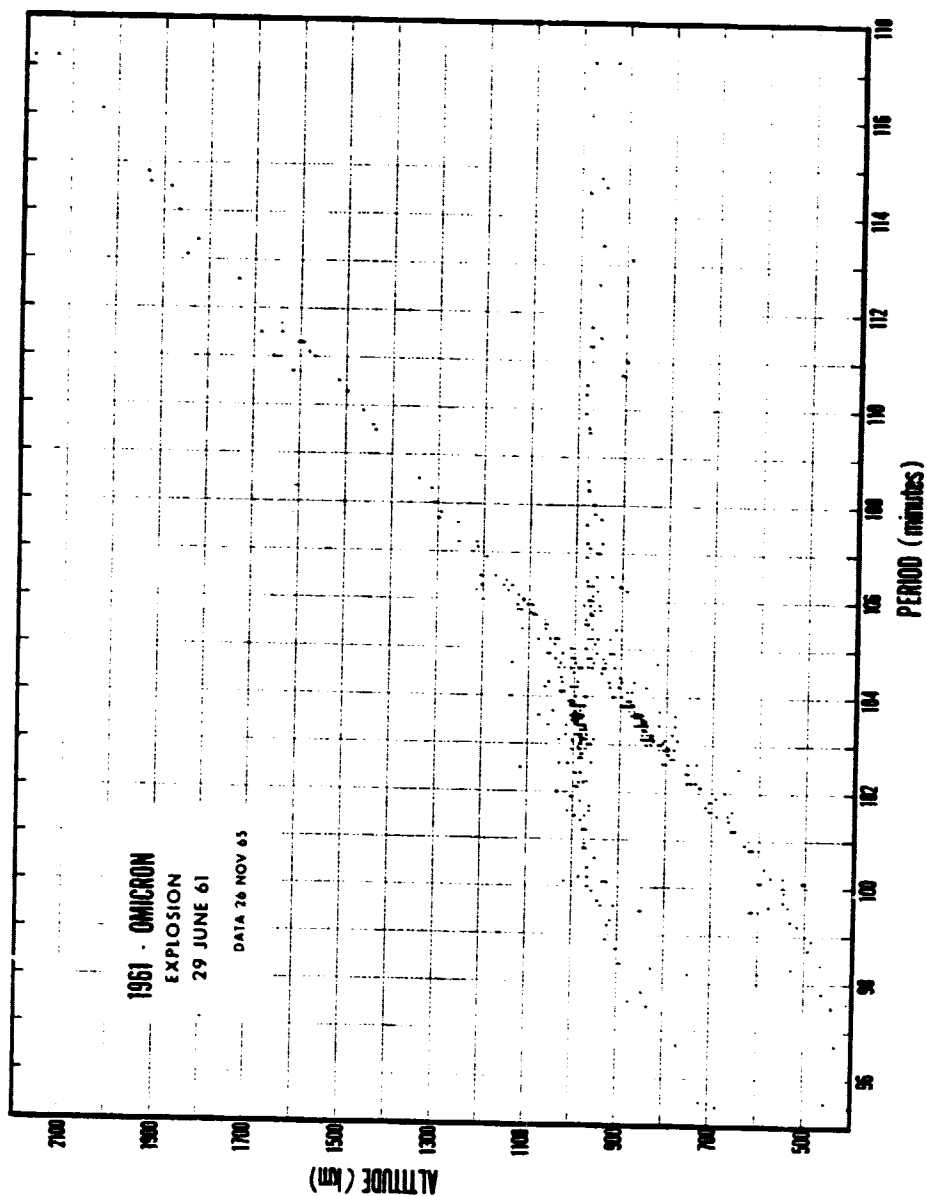
TRUE ANOMALY: 183°

- COMMENTS:
- The Ablestar rocket fragmented before it could be cataloged, therefore, no catalog number was assigned to the rocket.
 - The orbital information given is for one of the payloads, Transit 4A, satellite number 116.
 - No element set is available for the rocket but a "Moonwatch" team headed by Arthur Leonard of Davis, California observed the rocket ahead of the two payloads at 0605:12 GMT, 29 June 1961.
 - Separation between payloads and rocket at 0608:10 GMT was approximately 68 km.
 - The Organ Pass, New Mexico Baker-Nunn camera operated by the Smithsonian took a photograph at 0608:09 which showed three distinct objects which were judged to be the rocket and two payloads (2 of the 3 payloads did not separate). A subsequent frame at 0608:11 continued to show two payloads but in the area where the rocket should have been, a patchy and distributed image was apparent. The next frame at 0608:13 showed the two payloads and the patchy image slightly enlarged.
 - General shape of rocket; cylinder; length 4.8 m; dia. 1.4 m; weight 450 kg.

- CAUSE:
- Potential causes listed by Aerospace Corp., "Transit 4-A Ablestar Vehicle Fragmentation Study" para. 4 are:
 1. Propulsion system valve leakage.
 2. Abnormal electrical system operation.
 3. Meteoric impact.
 4. Command destruct activation.
 5. Other
 - Cited study on file at Teledyne Brown Engineering, Colorado Springs, Colorado.

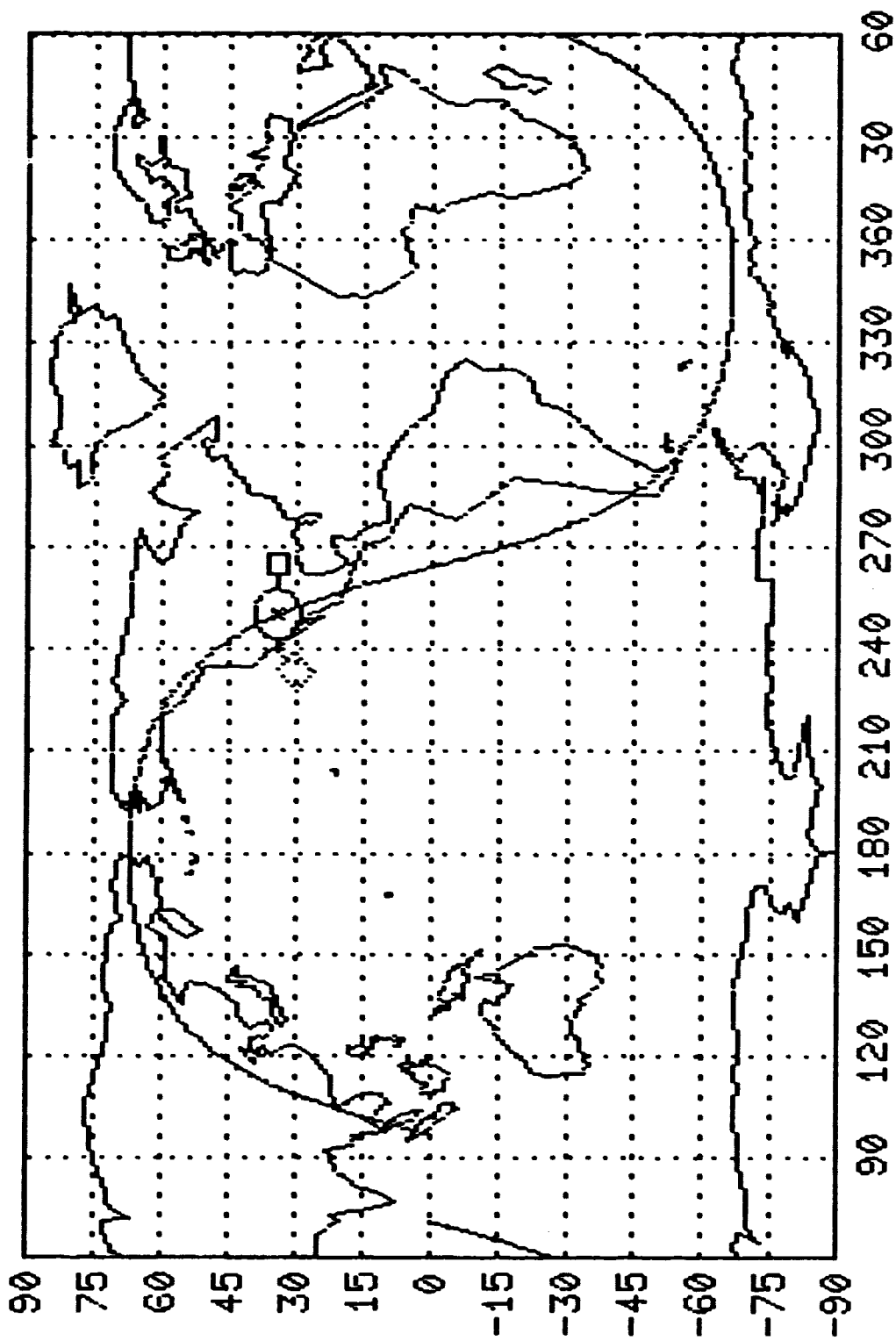
1961-Omicron

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TRANSIT 4A R/B

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TRANSIT 4A R/B

LAUNCH DATE: 24.(75?) Oct 1962

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 29 Oct 1962 (DAY 302)

TIME:

LOCATICN:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 23

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 65.11°

APOGEE: 261 km

PERIGEE: 202 km

PERIOD: 89.1 min

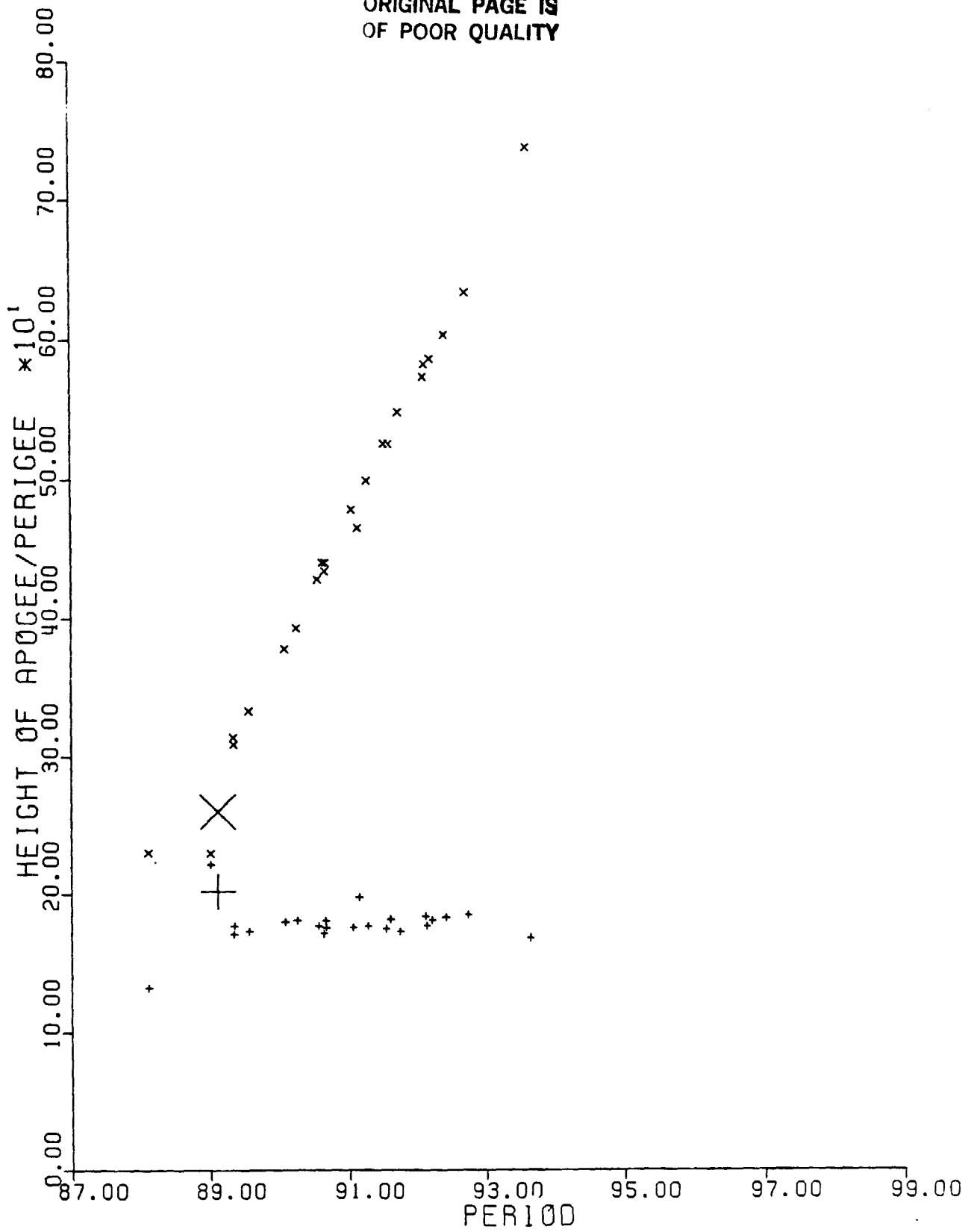
TRUE ANOMALY:

COMMENTS:

- Probable Mars probe failure.
- This launch is also known as Sputnik 22. To-date the USSR has not acknowledged this launch.
- Orbital characteristics derived from element set #1 of satellite 443.
- General shape; cylinder; length 7m?; dia. 2m; weight full 6500 kg?
- Insufficient data available to determine time and location of the event.

CAUSE: Probable propulsion failure during transfer orbit maneuver.

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SPUTNIK 29

COMMENTS: • Insufficient data to show an appropriate ground track for
Sputnik 29.

1962-B Iota

1963-47

ATLAS CENTAUR 2 ROCKET

694

LAUNCH DATE: 27.79 Nov 1963

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 27 Nov 1963 (DAY 331)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 14

PIECES STILL IN ORBIT (1 JAN 84): 12

ORBIT CHARACTERISTICS:

INCLINATION: 29.94°

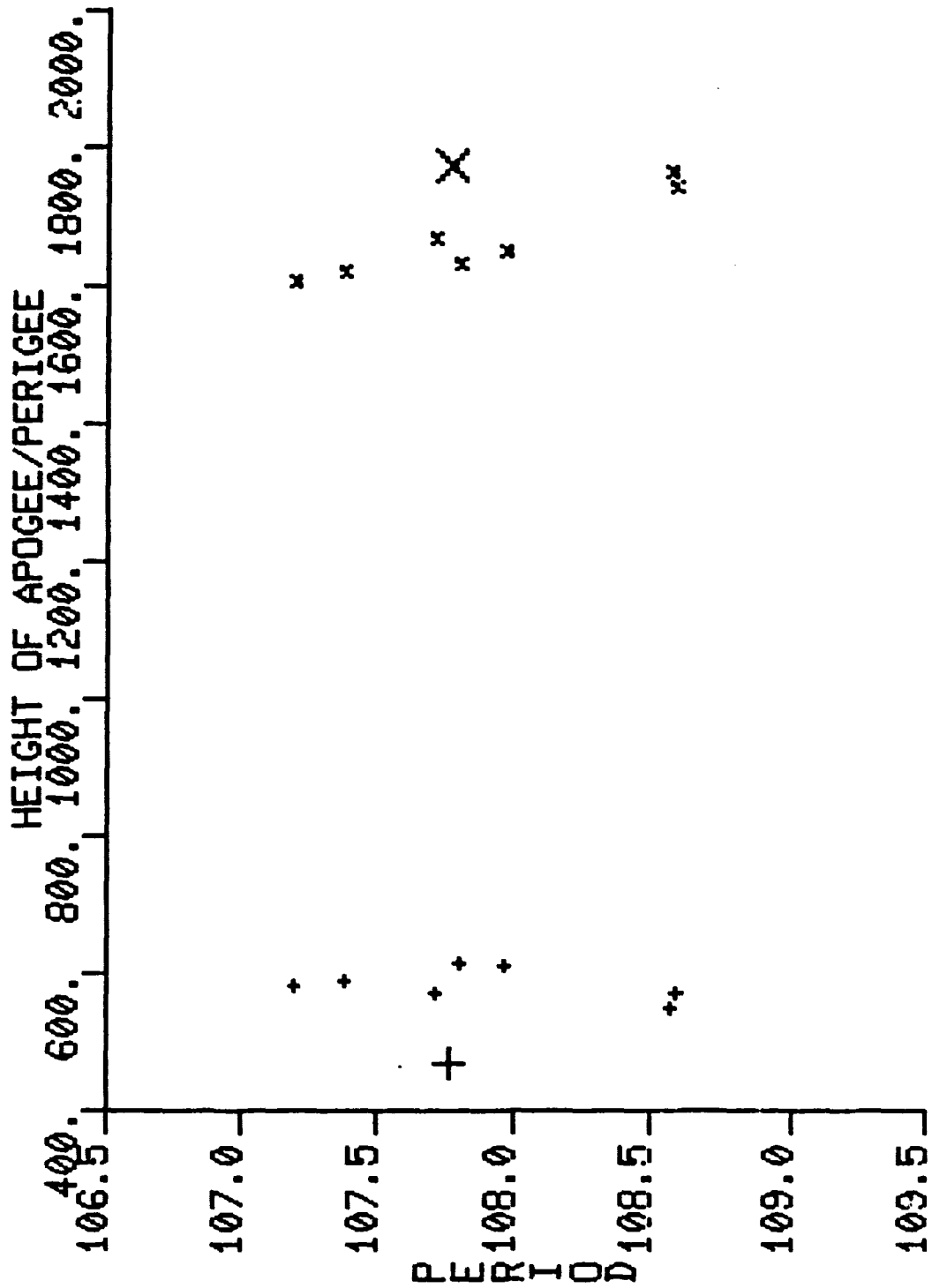
APOGEE: 1735 km

PERIGEE: 502 km

PERIOD: 107.7 min

TRUE ANOMALY:

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ATLAS CENTAUR 2 ROCKET

- COMMENTS:
- Centaur 2nd stage. Length 8.6m; Diameter 3 m. Propellants LH_2 /LOX pump fed. Thrust 13,500 kg total from 2 engines. Weight 4,590 kg empty.
 - This satellite is listed as a payload in the NORAD catalog, however, this was the 2nd flight test of the Atlas Centaur and carried no payload. The 1st flight test failed 5-8-62.
 - Element set #1 was developed 12 hrs. after launch resulting in an orbit with a period of 99.55 minutes and does not fit with the distribution of the orbits of fragments. Element set #2 results in an orbit with a period of 107.66 minutes and this orbit fits well with the distribution of the orbits of the fragments. Actual orbit manipulations have not been confirmed but is assumed the Centaur thrusted from the first to the second orbit and exploded. One of the fragments was then designated to continue as satellite 694. Element set #2 on 694 (a fragment) was used to develop the orbit characteristics shown.

CAUSE: Unknown. Assume fuel leak/engine failure.

COMMENTS • Insufficient data available to determine an appropriate ground track for satellite 694.

1963-47

1964-26

OPS 4412 R/B

809

LAUNCH DATE: 4.16 Jun 1964

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: Jan-Feb 1966

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 11

PIECES STILL IN ORBIT (1 JAN 84): 3

ORBIT CHARACTERISTICS:

INCLINATION: 90.5°

APOGEE: 935 km

PERIGEE: 848 km

PERIOD: 102.8 km

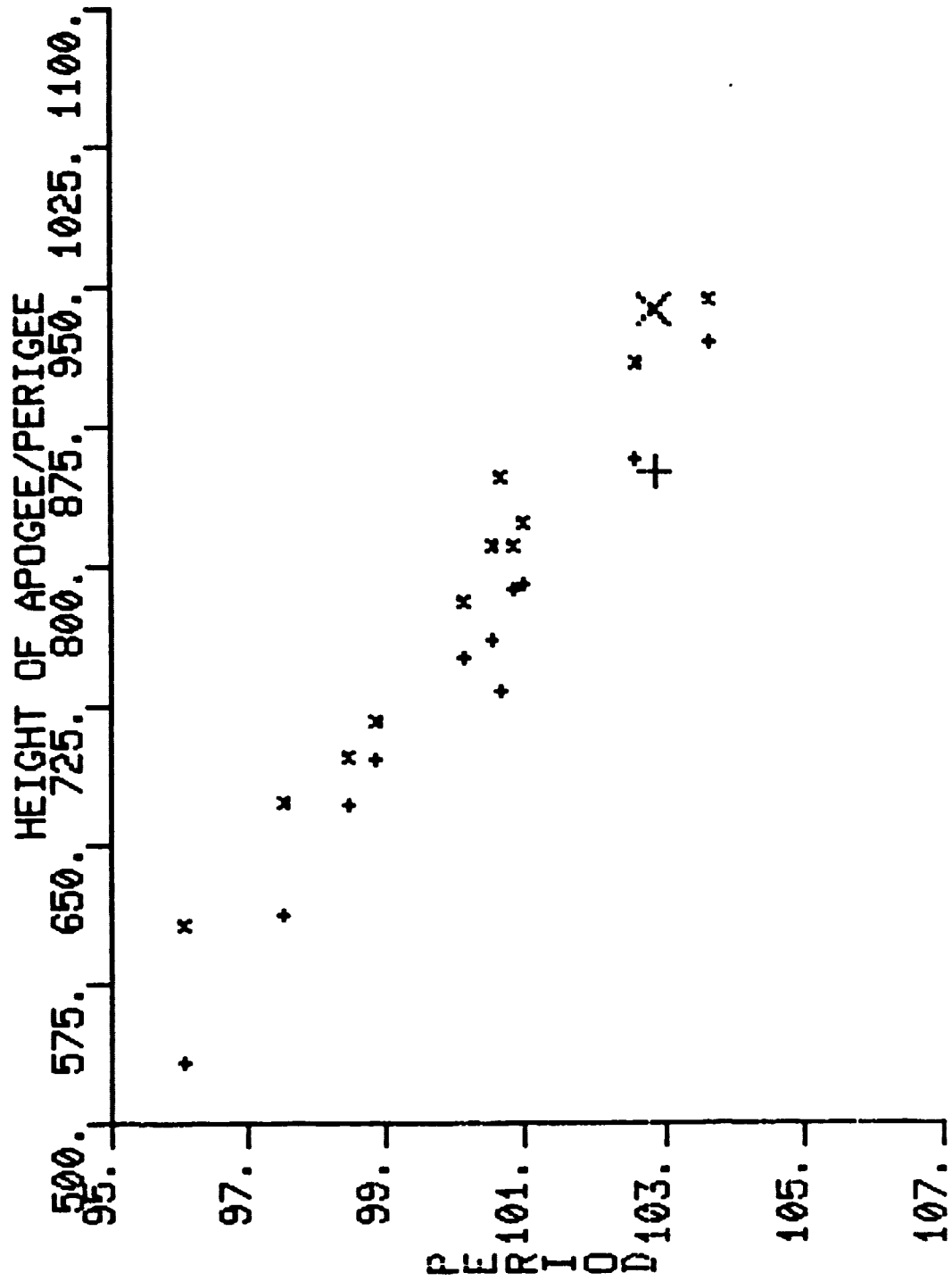
TRUE ANOMALY:

- COMMENTS:
- Satellite 809 is an assumed parent. It was an Altair rocket; weight 24 kg; length 1.5 m; dia. 0.46 m.
 - Eleven small debris type objects were cataloged at various times among several launches that had taken place long before the small objects were found in space. The orbits of these objects were not in reasonable locations relative to the launches they were cataloged with. The only reasonable association was inclination. Plots of this debris shows systematic trending of the apogees/perigees and the trends fall very close to the payload and rocket of the 64-26 launch. Details leading to this assumed event are recorded in Technical Memorandum 81-6, Directorate of Analysis DCS/ Plans, Programs, Policy and Requirements, Headquarters NORAD/ADCOM, Peterston AFB, Colorado Springs, Colorado.
 - The eleven objects are: 1399, 2086, 2335, 3809, 4587, 5363, 6290, 6372, 7259, 7558, 8000
 - Insufficient data is available to determine the time and location of the assumed event.

CAUSE: Unknown

1964-26

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OPS 4412 ROCKET

COMMENTS: • Insufficient data available to determine an appropriate ground track for satellite 809, Ops. 4412.

1964-70

COSMOS 50

919

LAUNCH DATE: 28.45 OCT 1964

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 5 NOV 1964 (DAY 310)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 95

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 51.23°

APOGEE: 233 km

PERIGEE: 188 km

PERIOD: 88.7 min

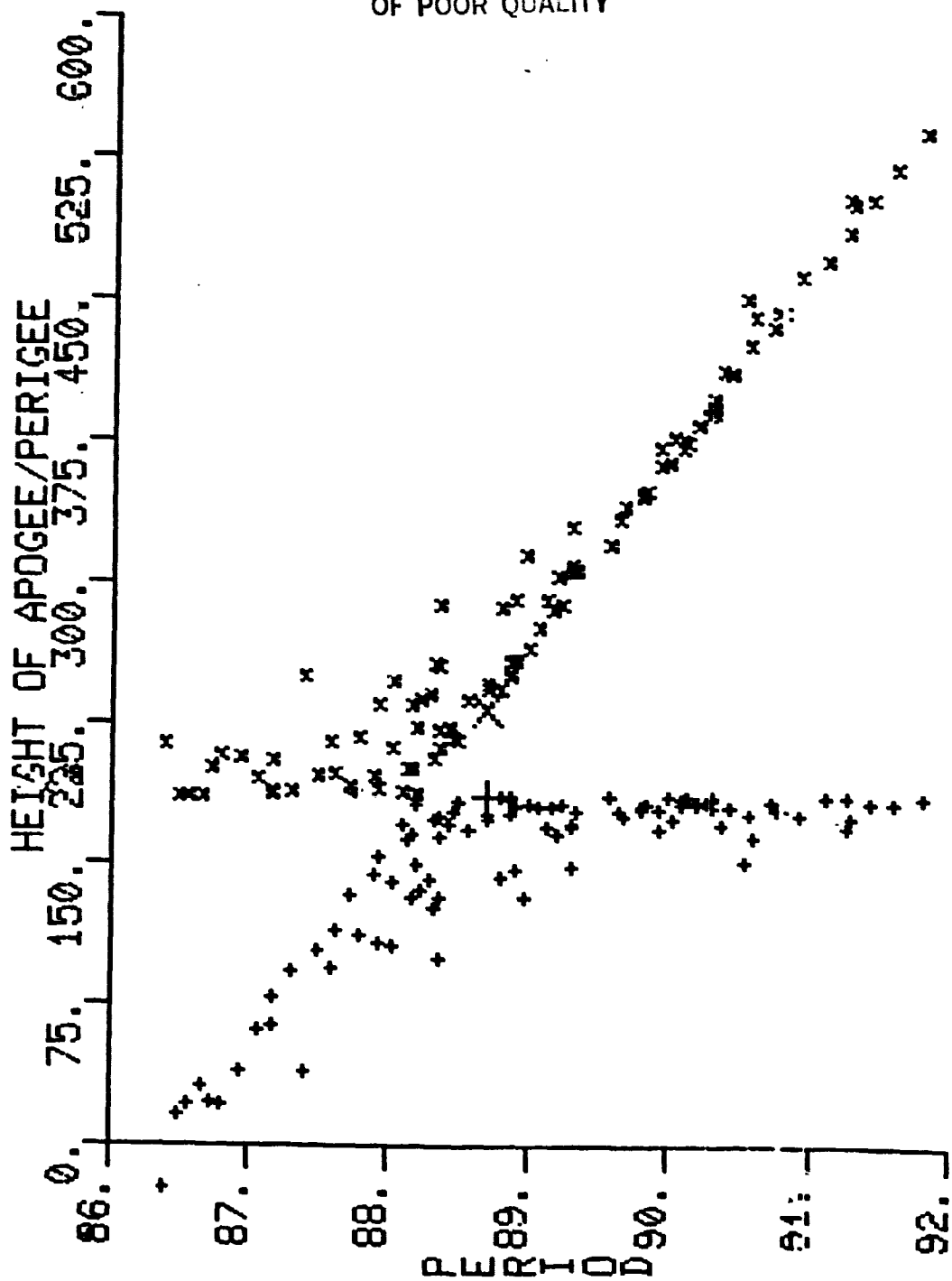
TRUE ANOMALY:

- COMMENTS:
- This payload had a general shape of a sphere-cylinder; length 4.3 m; dia. 2.4 m; weight 4750 kg?
 - The fragmentation was very low in altitude and orbital elements were not developed on any of the fragments. The piece count is an estimate made by the USAF.
 - The orbital data was developed from element set #3 of 919 which had an epoch of 30 Oct 1964. These are the elements nearest the event date that are available.
 - Fragment found in the Mzuzu area of Malawi. See Royal Aircraft Establishment Technical Report No. 65165, August, 1965.

CAUSE: Apparently intentionally detonated due to the failure of satellite 919 to respond to a signal to deorbit.

1964-70

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COSMOS 50
SIMULATION

COMMENTS: • Insufficient data available to show an applicable ground trace for satellite 919.

1964-70

1965-12

COSMOS 57

1093

LAUNCH DATE: 22.32 FEB 1965

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 22 Feb 1965 (DAY 53)

TIME: 0957 GMT

LOCATION: 64 S/284 E

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 166

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 64.8°

APOGEE:

PERIGEE:

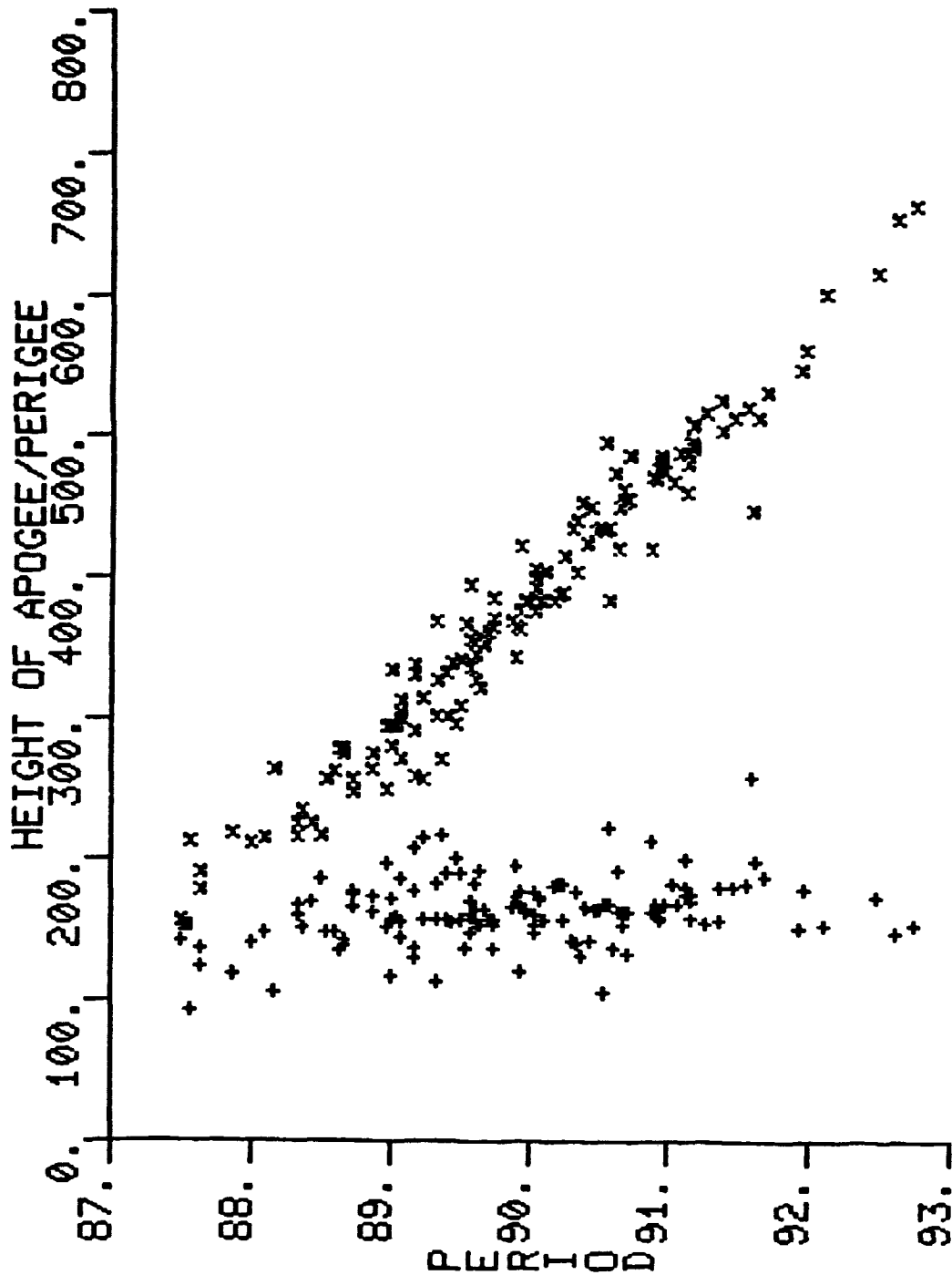
PERIOD:

TRUE ANOMALY:

- COMMENTS:**
- Payload had a general shape of spheric-cylinder; length 6 m; dia. 2.4 m; weight 5,500 kg?
 - This was an unmanned Voskhod test flight.
 - 34 of the cataloged objects were cataloged with "no initial elements." This count is an USAF estimate of very low orbiting pieces that could not be tracked enough to develop elements.
 - A "BMEWS-ADC Systems Engineering Memorandum," dated 16 June 1965, discusses this event. This document is on file at Teledyne Brown Engineering, Colorado Springs, Colorado office.
 - Satellite 1093 fragmented approximately 1½ revolutions after launch.
 - Orbit at the time of break-up is unknown as a result of maneuvers prior to the event.

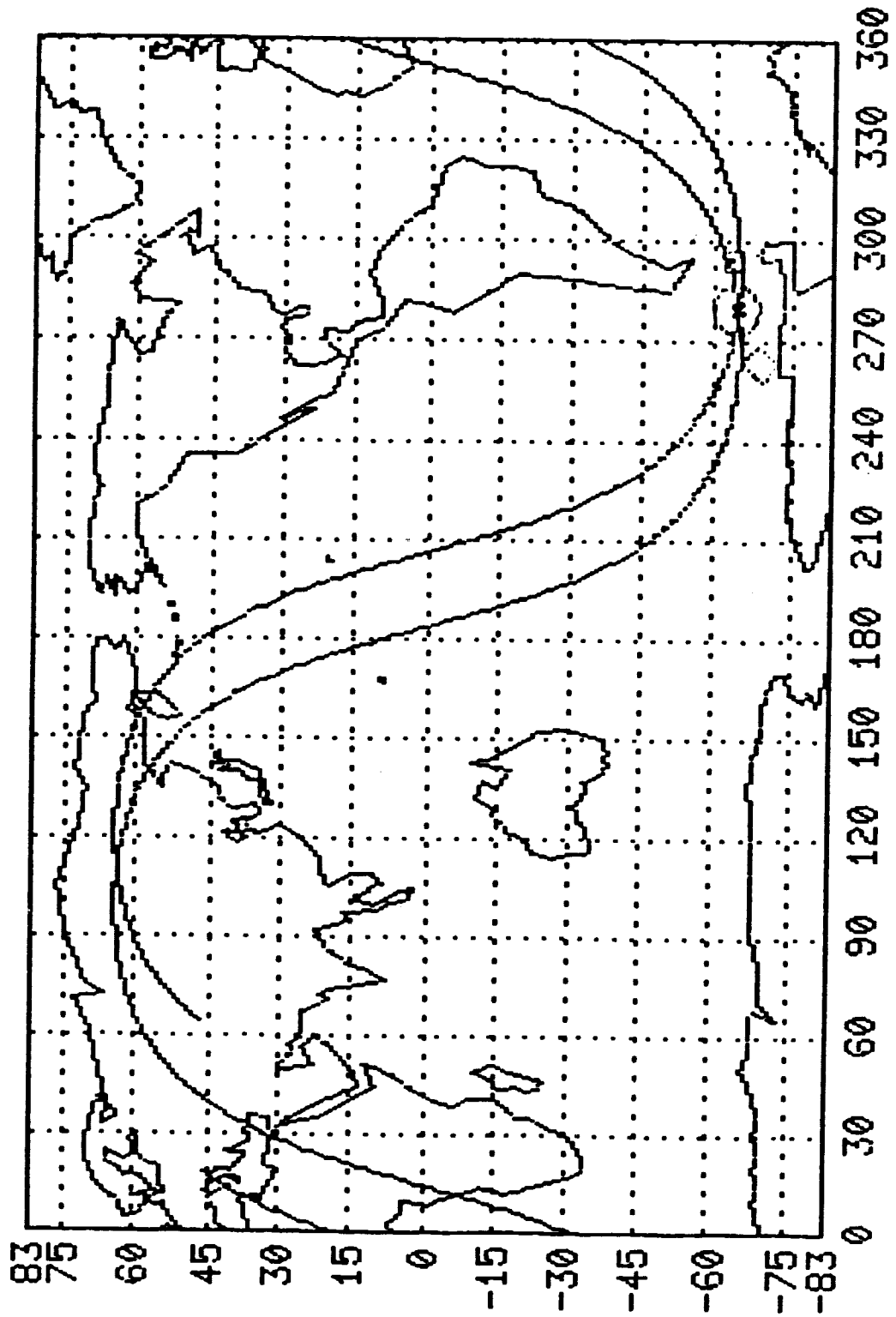
CAUSE: Unknown

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COSMOS 57

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COSMOS 57

1965-20

COSMOS 61- 63 ROCKET

1270

LAUNCH DATE: 15.46 Mar 1965

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 15 Mar 1965 (DAY 74)

TIME: 171350.0 GMT

LOCATION: 51 S/162 E

ALTITUDE: 1639 km

PIECES CATALOGED (1 JAN 84): 147

PIECES STILL IN ORBIT (1 JAN 84): 26

ORBIT CHARACTERISTICS:

INCLINATION: 56.05°

APOGEE: 1827 km

PERIGEE: 260 km

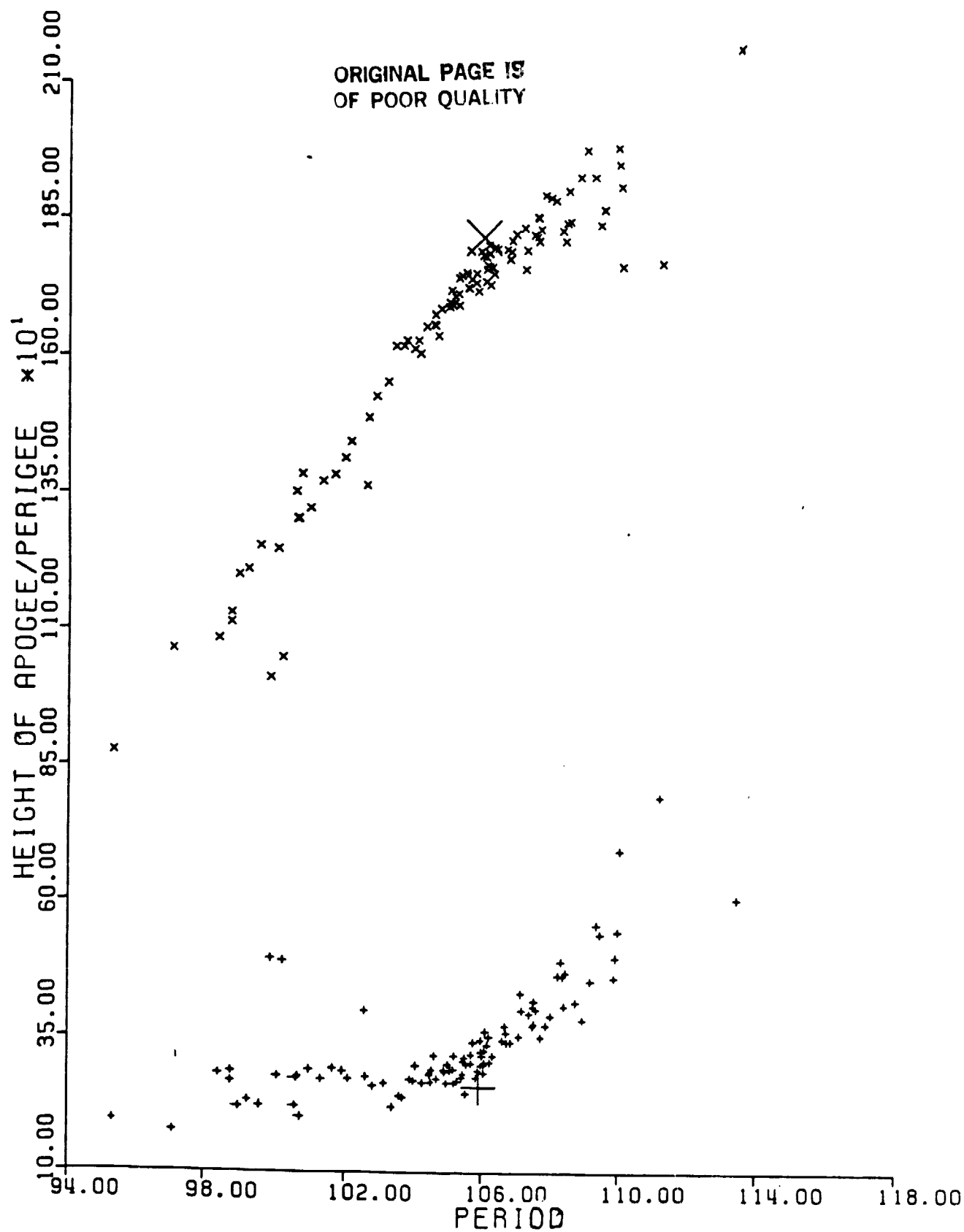
PERIOD: 106.0 min

TRUE ANOMALY: 143 °

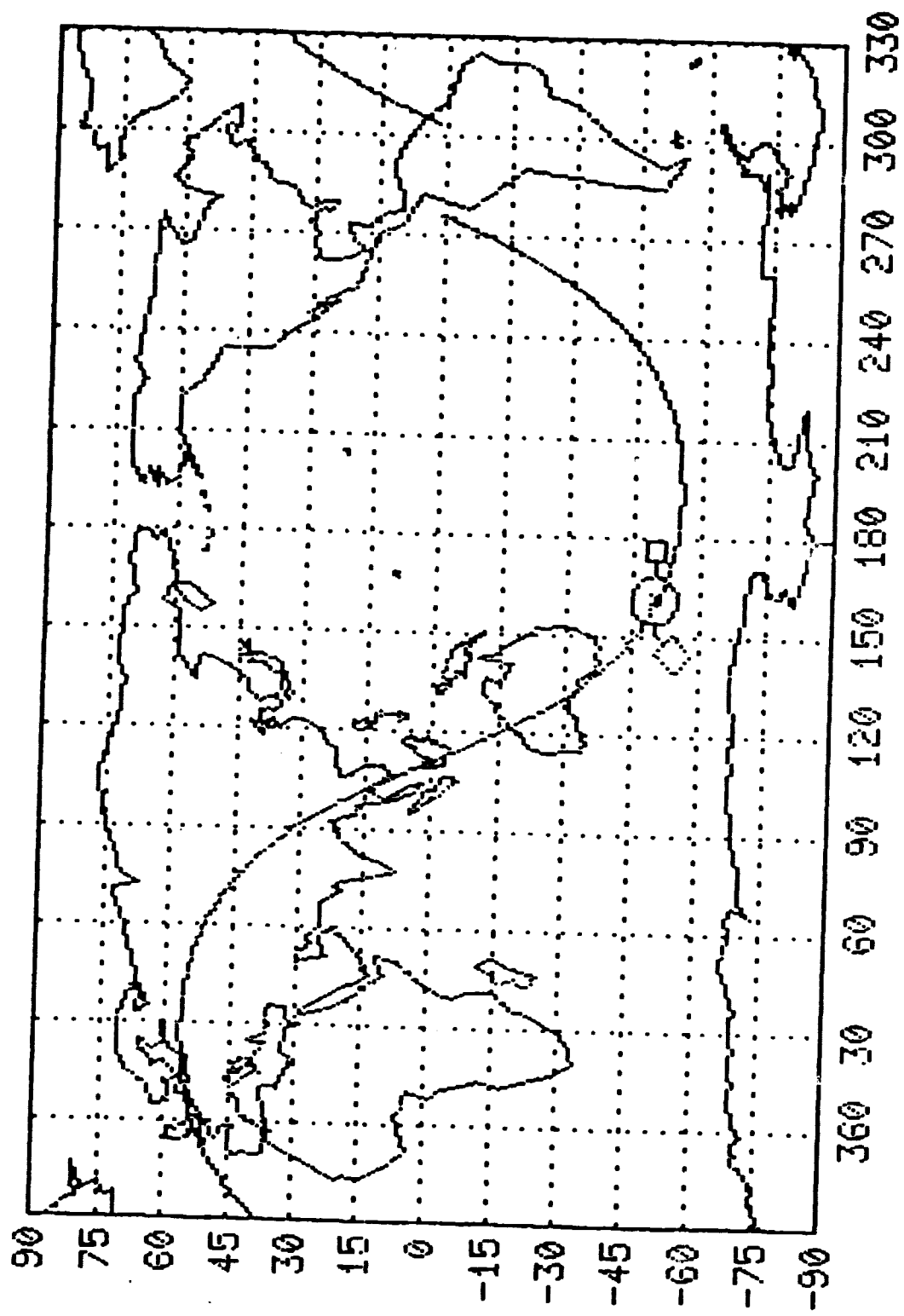
- COMMENTS:**
- General shape was cylindrical; length 7.4 m; dia. 2.4 m; weight 2200 kg?
 - This was the third triple payload launch by the USSR. It was a communications satellite test launch.
 - Orbit characteristics were derived from element set #1 satellite 1270.

CAUSE: Unknown

1965-20



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COSMOS 61-63 R/B

1965-82

TITAN 3C-4

1640

LAUNCH DATE: 15.72 Oct 1965

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 15 Oct 1965 (DAY 288)

TIME: 1820 GMT

LOCATION: 2° S/108 E

ALTITUDE: 739 km

PIECES CATALOGED (1 JAN 84): 464

PIECES STILL IN ORBIT (1 JAN 84): 163

ORBIT CHARACTERISTICS:

INCLINATION: 32.6°

APOGEE: 791 km

PERIGEE: 708 km

PERIOD: 99.8 min

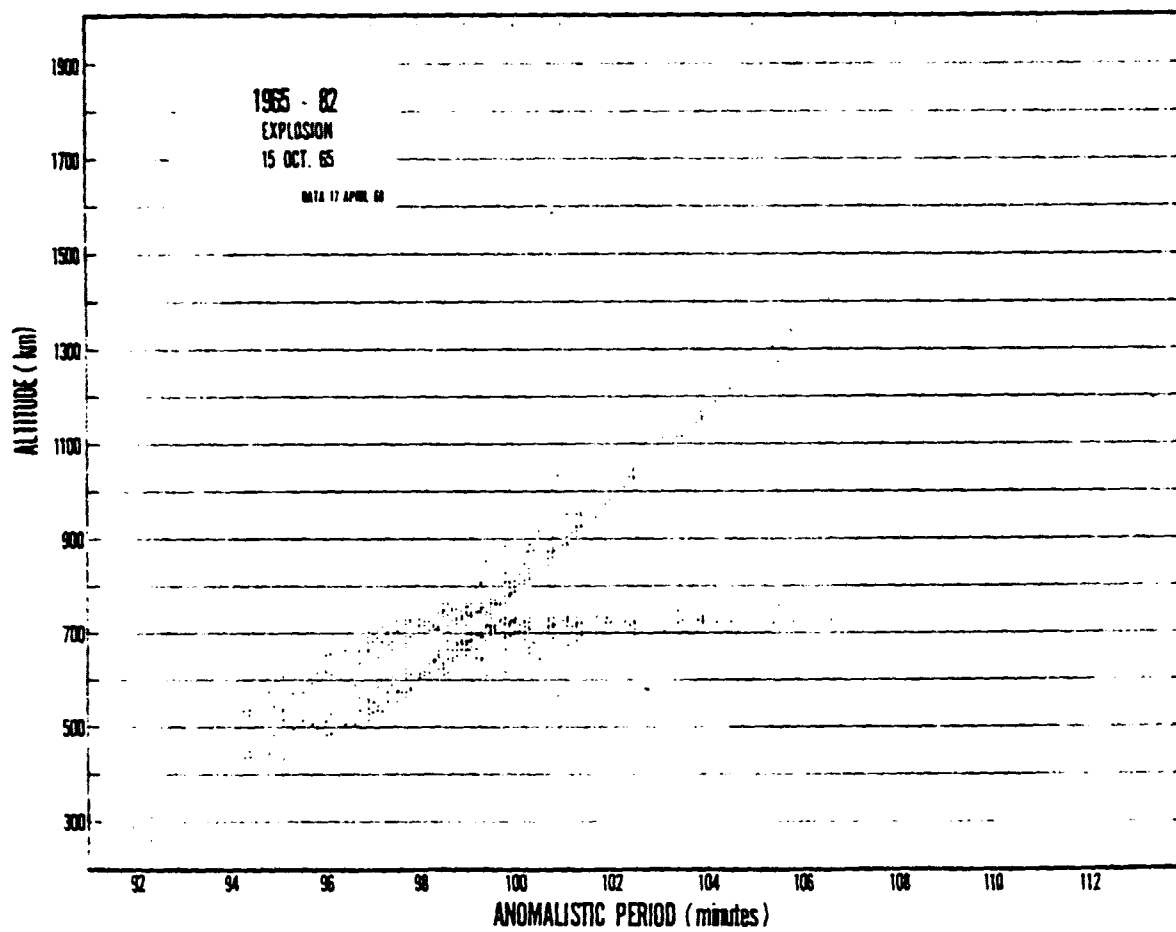
TRUE ANOMALY:

- COMMENTS:
- Transtage fragmented.
 - General shape was cylindrical; length 6 m; dia. 3 m; weight 1500 kg? Lester Sobel's Space: From Sputnik to Gemini indicates mass was 3764.5 kg but does not qualify the rocket as full or empty of fuel.
 - Payloads OV2-1 and LCS-2 did not separate from the transtage.
 - The restartable transtage employed one AJ10-138 engine with storable hypergolic propellants and produced 7,257.0 kg of thrust.
 - The orbit characteristics shown are from the initial elements on file for satellite 1624, the OV2-1, LCS-2 payloads.
 - The main body of OV2-1 was 23 in. square and 24 in. long. There were 4 solar panels. Total weight was 375 lbs. The LCS-2 was a highly polished rigid hollow sphere of 1/8 in. aluminum sheet and weighed 75 lbs.

CAUSE: Assume leak of hypergolic fuels.

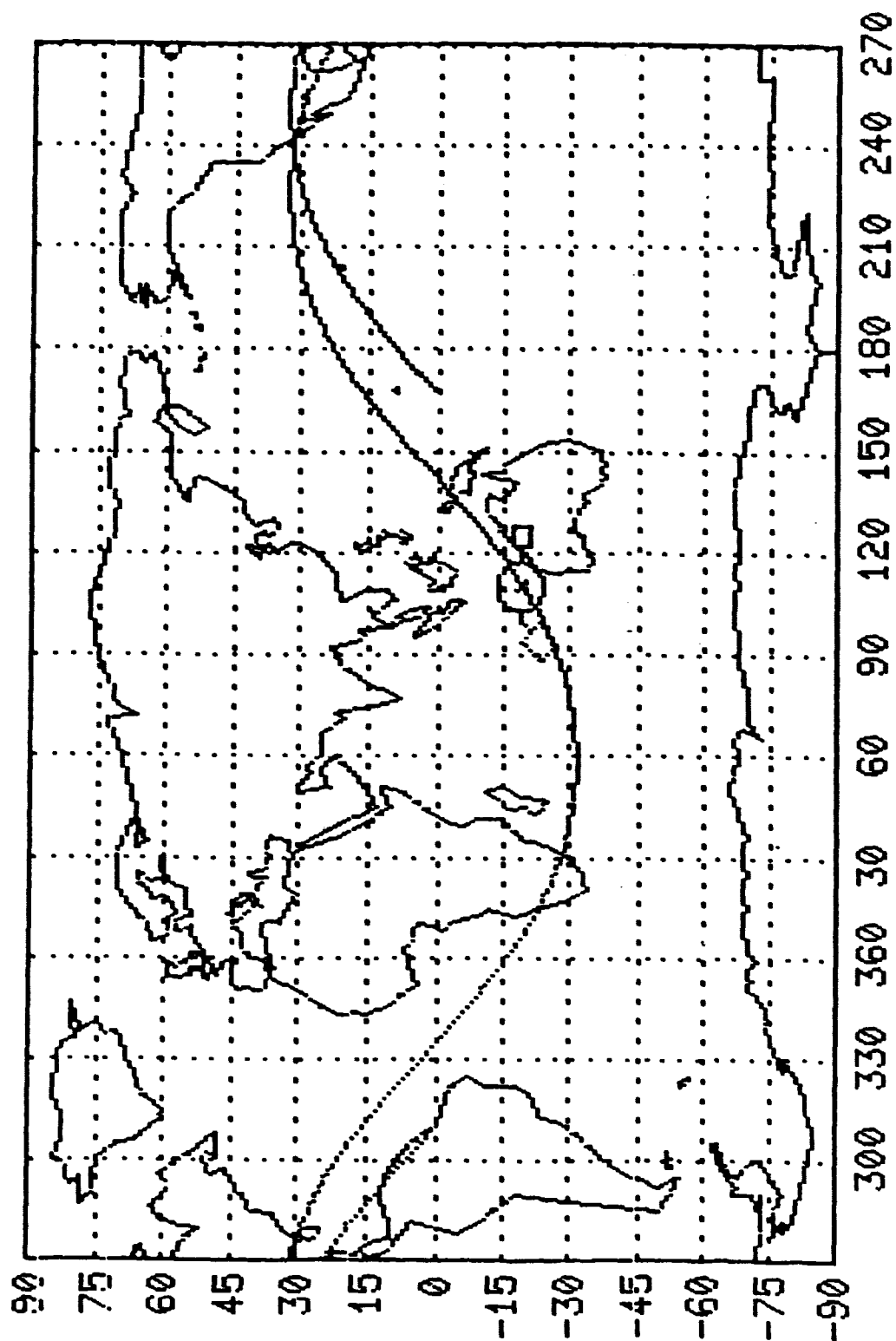
1965-82

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TITAN 3C-4

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TITAN 5C-4

1965-88

COSMOS 95

1706

LAUNCH DATE: 4.23 Nov 1965

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 4-15? Nov 1965 (DAY 308-319)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 21

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 48.44°

APOGEE: 521 km

PERIGEE: 211 km

PERIOD: 91.9 min

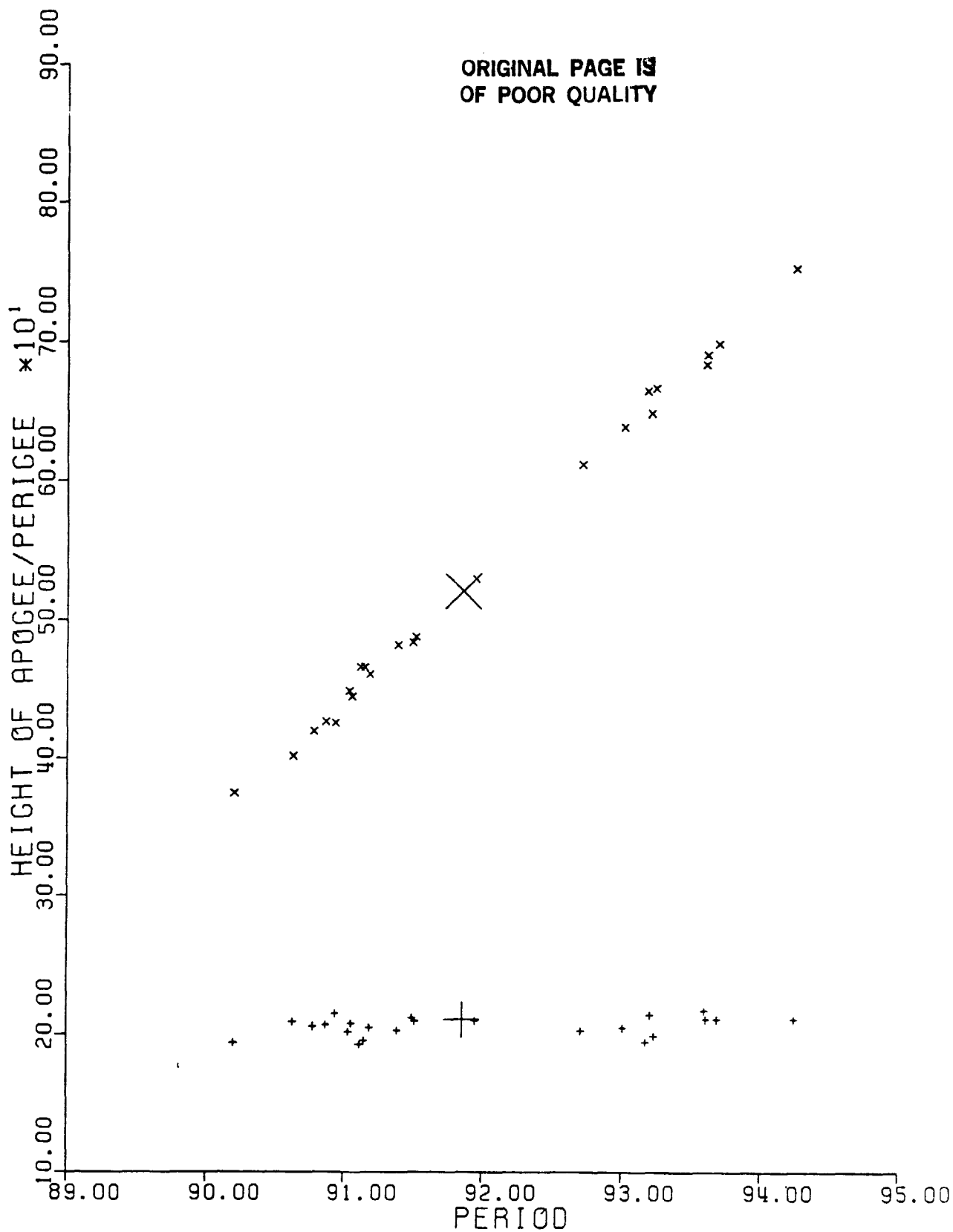
TRUE ANOMALY:

- COMMENTS:**
- The general shape of this payload was cylindrical; length 1.8 m; dia. 1.2 m; weight 400 kg?
 - The orbit characteristics were extracted from the initial element set generated for 1706 that remains on file in the USAF NSSC computer.
 - One fragment was cataloged near time of launch; two more between 19 and 20 Nov 1965; 19 cataloged between 27 and 29 Nov 1965.
 - Insufficient data is available to determine time and position for this event.

CAUSE: Unknown

1965-88

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COSMOS 95

COMMENTS: ° Insufficient data available to show the applicable ground trace for satellite 1706.

1965-88

1966-12

OPS 3031

2015

LAUNCH DATE: 15.85 Feb 1966

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 15 Feb 1966 (DAY 46)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 37

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 96.5°

APOGEE: 268 km

PERIGEE: 147 km

PERIOD: 88.6 min

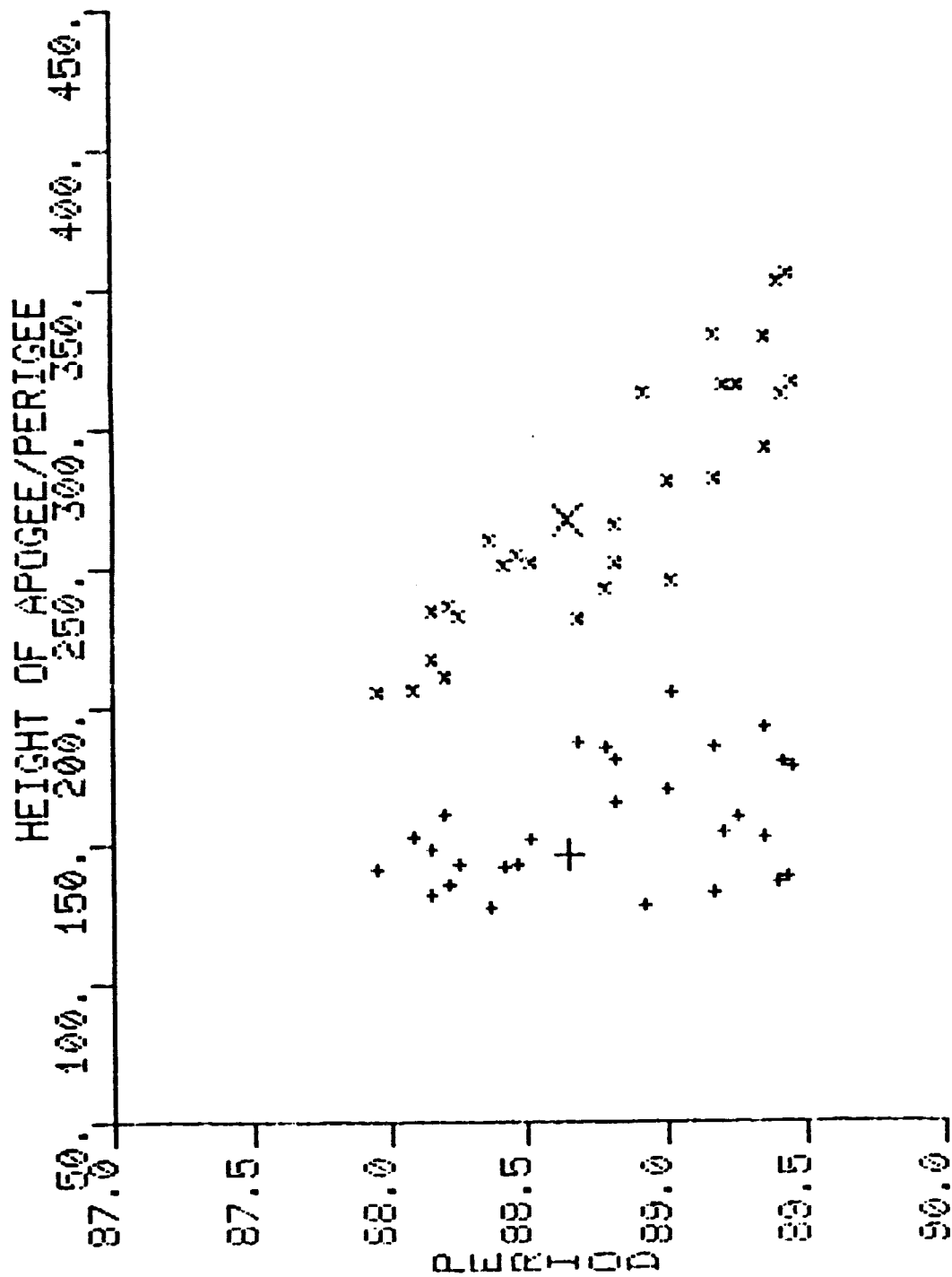
TRUE ANOMALY:

COMMENTS:

- Satellite 2015 was an inflated sphere; dia. 3m; weight 4.1 kg.
- There is no rocket cataloged with this launch. The launch hardware was an Atlas-Agena D. Three payloads launched.
- NORAD cataloged the fragments with payload 2015, Ops 3031.
- Payload 2014 was also an inflated sphere. 3 m in dia.; and payload 2012 was a capsule.
- Orbit characteristics derived from initial element set on satellite 2015.
- Parent identification tentative.
- Insufficient data is available to determine time and position for this event.

CAUSE: Unknown

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OPS 3031

COMMENTS: • Insufficient data available to show the applicable ground track for satellite 2015, Ops. 3031.

1966-12

1966-46

ATDA ROCKET

2188

LAUNCH DATE: 1.63 Jun 1966

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 21 Jun 1966

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 50

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 28.82°

APOGEE: 300 km

PERIGEE: 281 km

PERIOD: 90.3 min

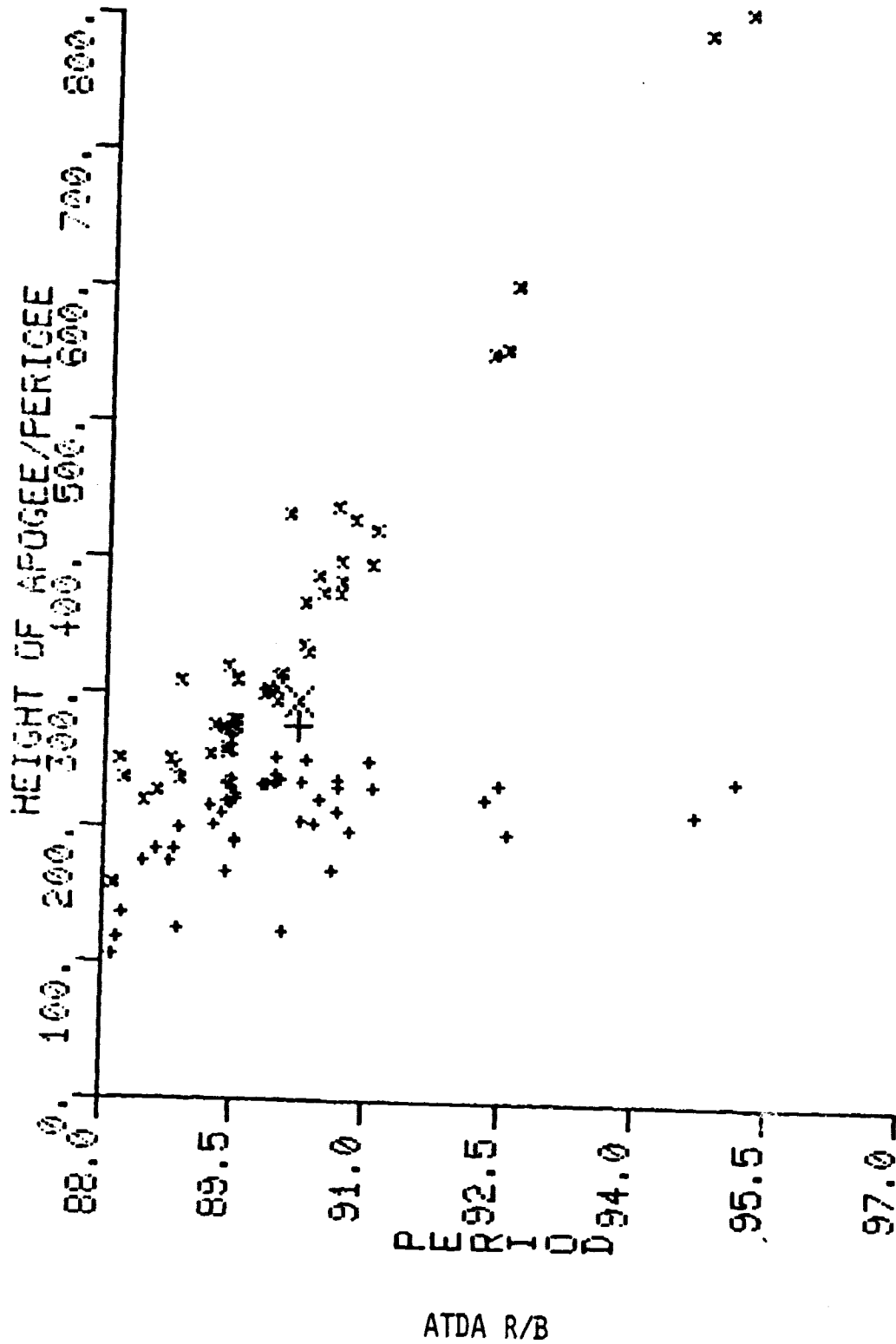
TRUE ANOMALY:

- COMMENTS:
- This was the Atlas rocket that launched the Gemini rendezvous and docking Agena Target Vehicle #9; Augmented Target Docking Adaptor (ATDA).
 - The orbit characteristics were derived from element set #1 for satellite 2188.
 - General shape; cylinder; length 20 m; dia. 3 m; weight 3400 kg.

CAUSE: Unknown

1966-46

ORIGINAL PAGE 13
OF POOR QUALITY



COMMENTS: ° Insufficient data available to show applicable ground trace for satellite 2188.

1966-46

LAUNCH DATE: 24.01 Jun 1966

COUNTRY OF ORIGIN: US

EVENT DATA:	1.	2.	3.
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DATE:	12 Jul 1975 (DAY 193)	20 Jan 1976 (DAY 20)	Jun 78
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TIME:	224757.9 GMT	013000.0 GMT \pm 3 hrs.	
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LOCATION: 67 N/135 E

ALTITUDE: 5144 km

PIECES CATALOGED (1 JAN 84): 75

PIECES STILL IN ORBIT (1 JAN 84): 13

ORBIT CHARACTERISTICS:

INCLINATION:	85.28°	85.07°	84.6°
APOGEE:	5169 km	5424 km	5750 km
PERIGEE:	3201 km	2934 km	2629 km
PERIOD:	180.1 min	179.9 min	180.1 min
TRUE ANOMALY:	192°		

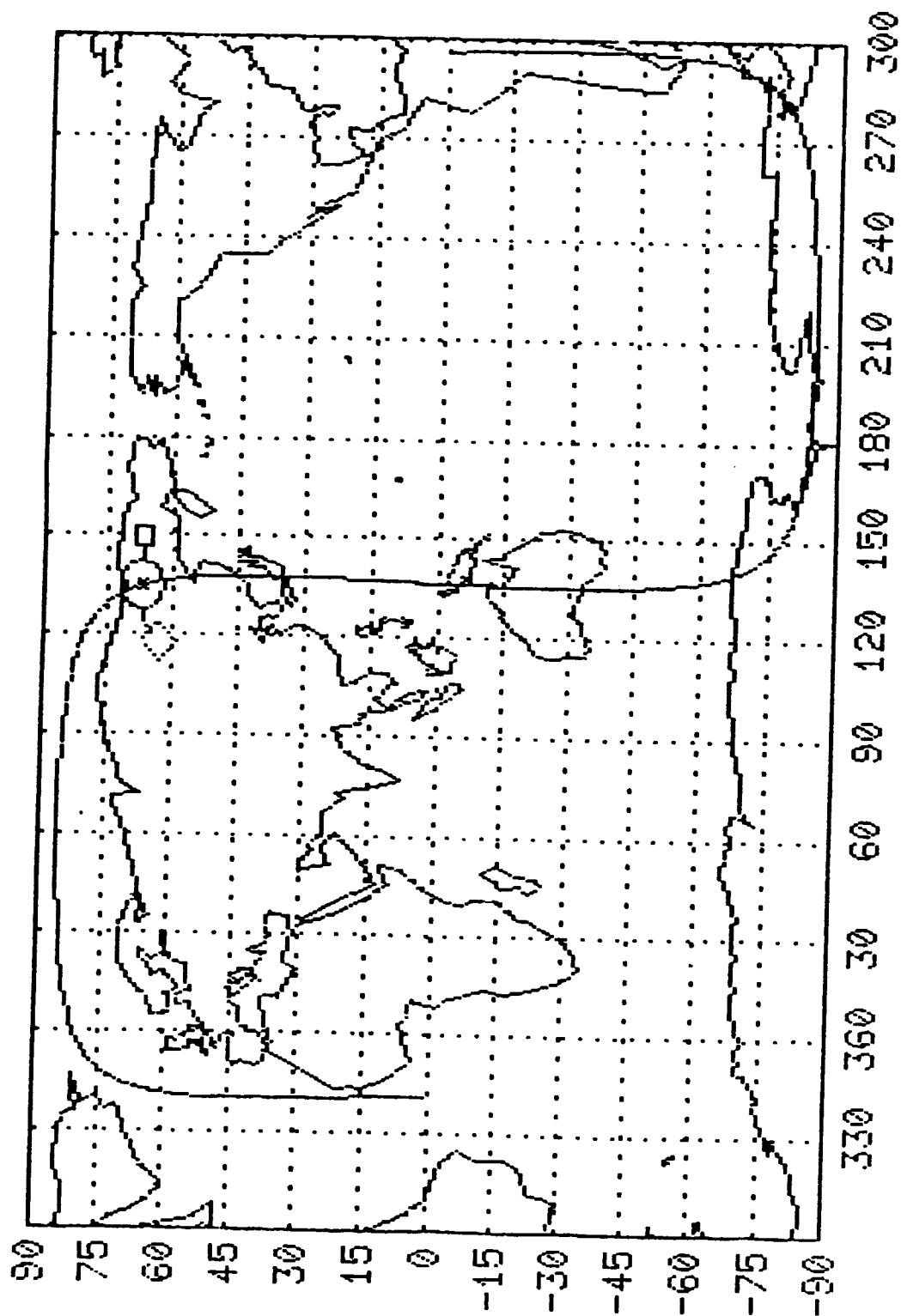
- COMMENTS:**
- Payload 2253 was a 30.48 m alumized mylar balloon.
 - See NORAD Technical Memorandum 81-6 for details of this fragmentation.
 - 45 pieces were cataloged with no initial elements and 30 with elements.
 - The RAE Table of Earth Satellites indicated a fragment of Pageos fragmented into 44 pieces on 20 Jan 1976. NORAD had a provisional satellite number of 82130 for that fragment. This 2nd group of fragments was observed by King-Hele and P. Neirinick.
 - The time of the 2nd breakup was calculated by P. Neirinick based on optical observations.
 - A 3rd breakup was detected by optical observations from Dubai & Invercargill, England and North Canton, Ohio. Its epoch appears to be mid June 1978.

CAUSE: Unknown for the 1st event, collision appears to be a more elevated possibility than for many other fragmentation cases.

The Science Research Council, Appleton Laboratory, England has shown a general correlation between event time and object spin-up as the object moves to the position where its orbit grazes the earth shadow. Their data follows:

<u>Spin Up</u>	<u>Max. Spin</u>	<u>Shadow Grazing</u>	<u>Break-up</u>
?	?	2 Jul 75	12 Jul 75
?	?	11 Dec 75	20 Jan 76
2 Jun 78	22 Jun 78	5 Jul 78	19? Jun 78

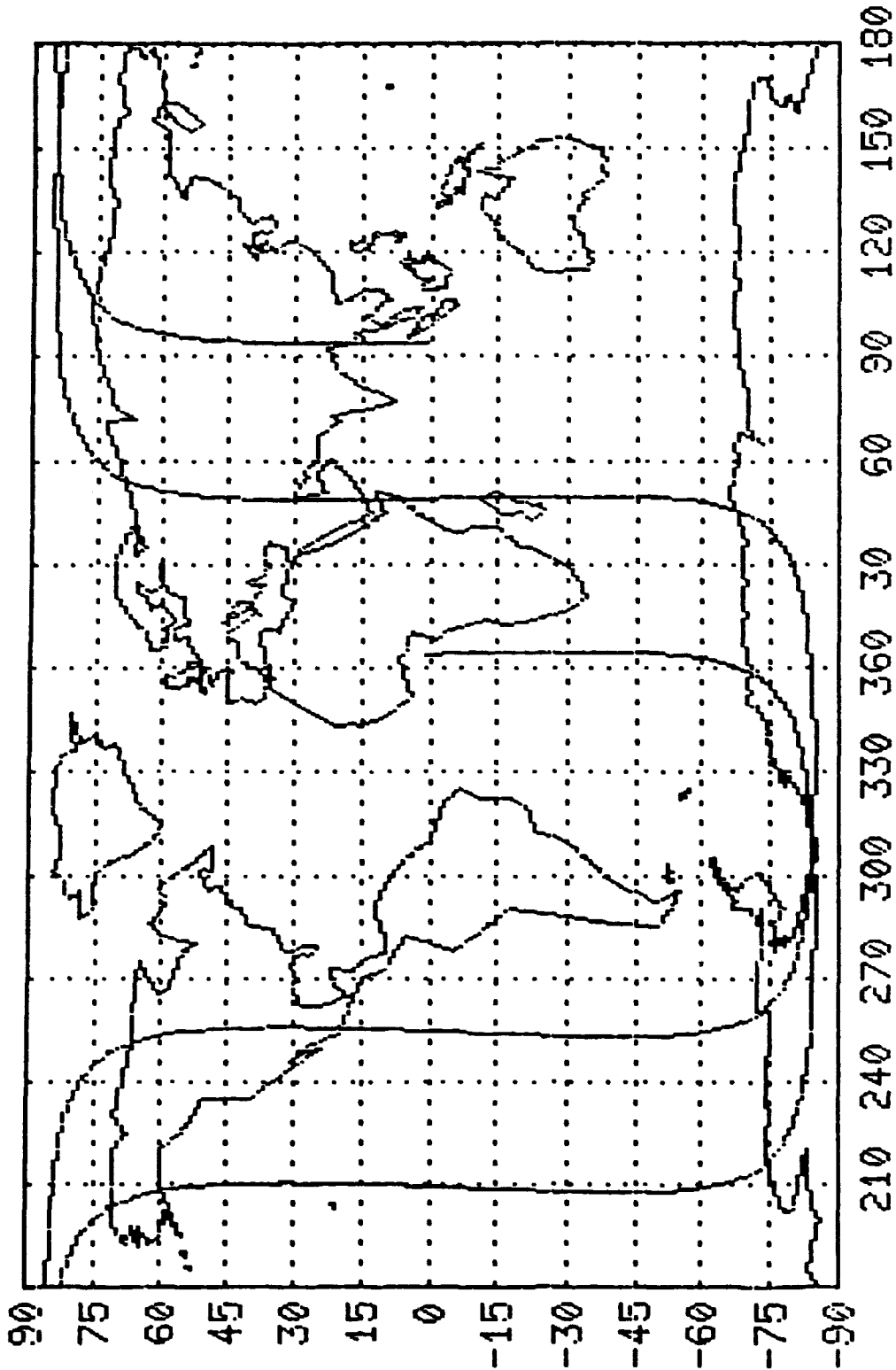
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COMMENTS: • Insufficient data to identify debris associated with the Second Event, therefore, an orbit distribution plot is not provided.

1966-56

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PAGE05 (EVENT 2)

COMMENTS: • Insufficient data to identify debris associated with the Third Event, therefore, an orbit distribution plot is not provided.

COMMENTS: • Insufficient data to show applicable ground track for
satellite 2256, Third Event.

1966-56

1966-59

SA-203 R/B

2289

LAUNCH DATE: 5.62 Jul 1966

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 5 Jul 1966 (DAY 186)

TIME: 211100.0 GMT

LOCATION: 20 N/277 E

ALTITUDE: 204 KM

PIECES CATALOGED (1 JAN 84): 33

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 31.98°

APOGEE: 214 km

PERIGEE: 185 km

PERIOD: 88.5 min

TRUE ANOMALY: 140°

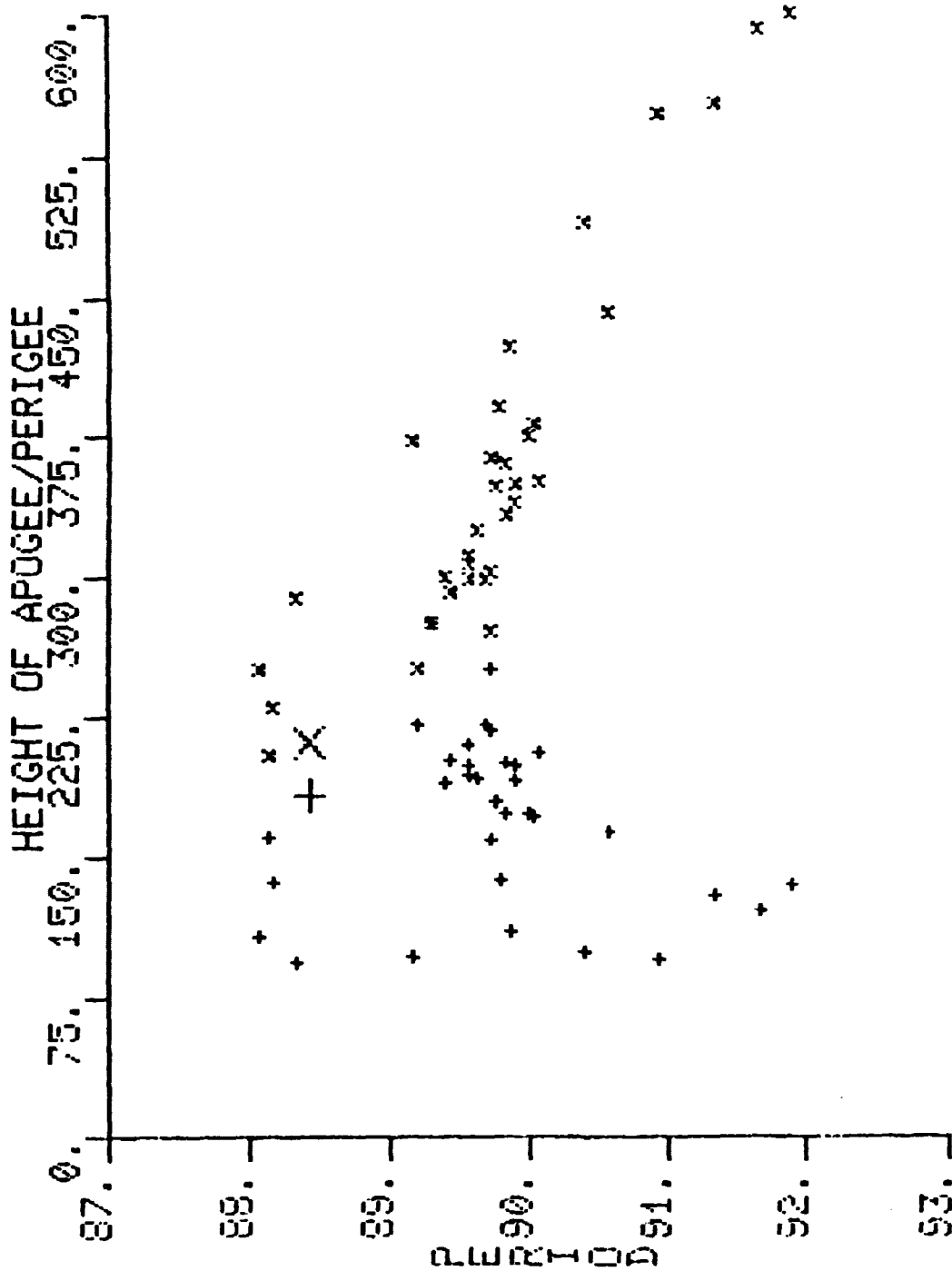
COMMENTS:

- This was a Saturn 1B launch associated with the Apollo program.
- The NORAD catalog carries the common name AS-203 and other documents refer to it as SA-203.
- The orbit characteristics were derived from element set #1 for satellite 2289.
- NORAD was unable to catalog the S-IVB stage prior to its fragmentation. Its length was 28.3 m; dia. 6.6 m; weight 26552 kg.
- This launch tested venting and restart of the S-IVB stage after a coast period. Later in the flight this stage was allowed to build pressure for a structures test which then exploded the S-IVB stage in orbit.

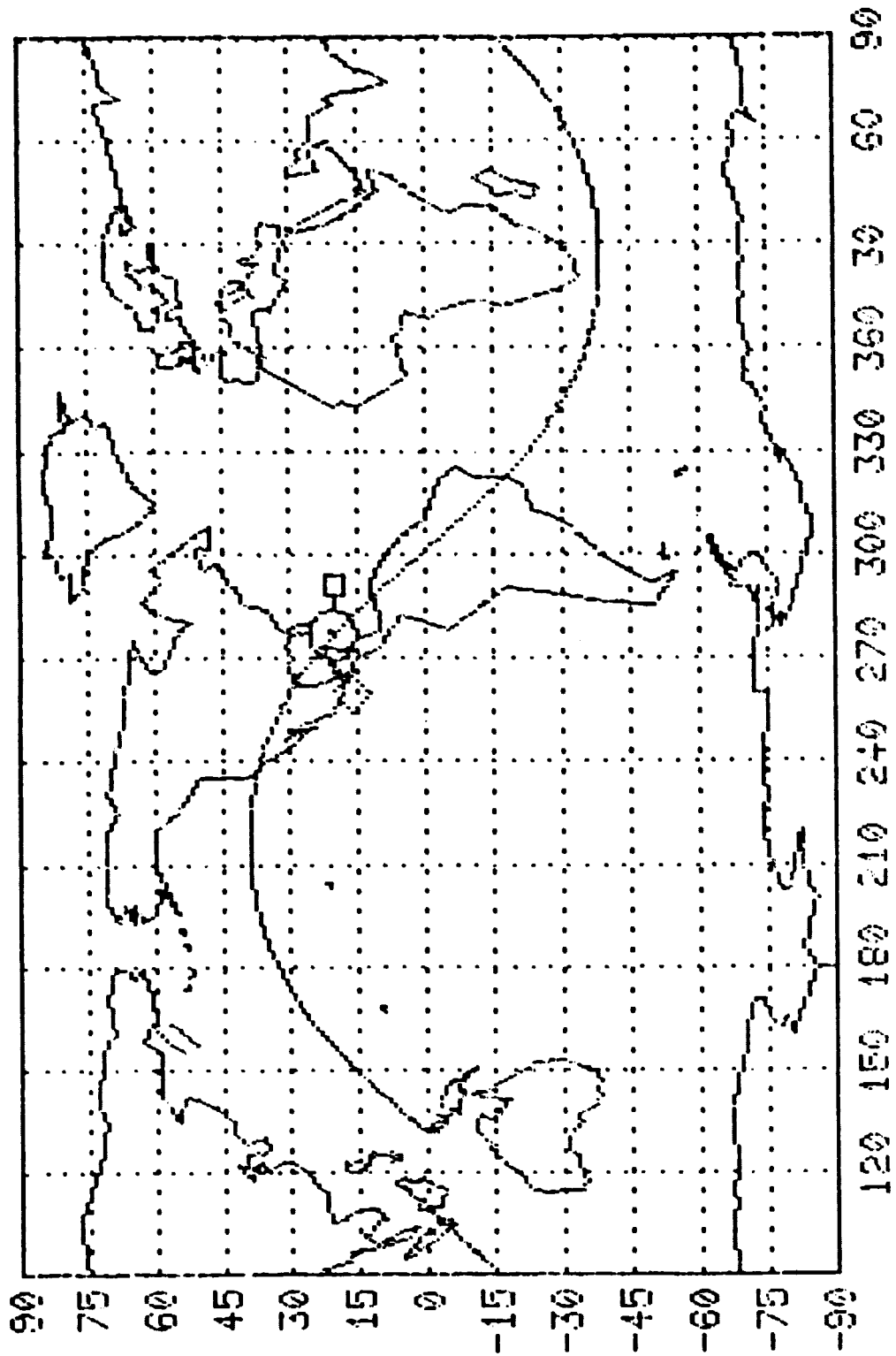
CAUSE: Planned structures test.

1966-59

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S/A 203 R/B

1966-88

USSR/Unknown 1

2437

LAUNCH DATE: 17.94 Sep 1966

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 17 Sep 1966 (DAY 260)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 54

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 49.6°

APOGEE: 792 km

PERIGEE: 138 km

PERIOD: 93.9 min

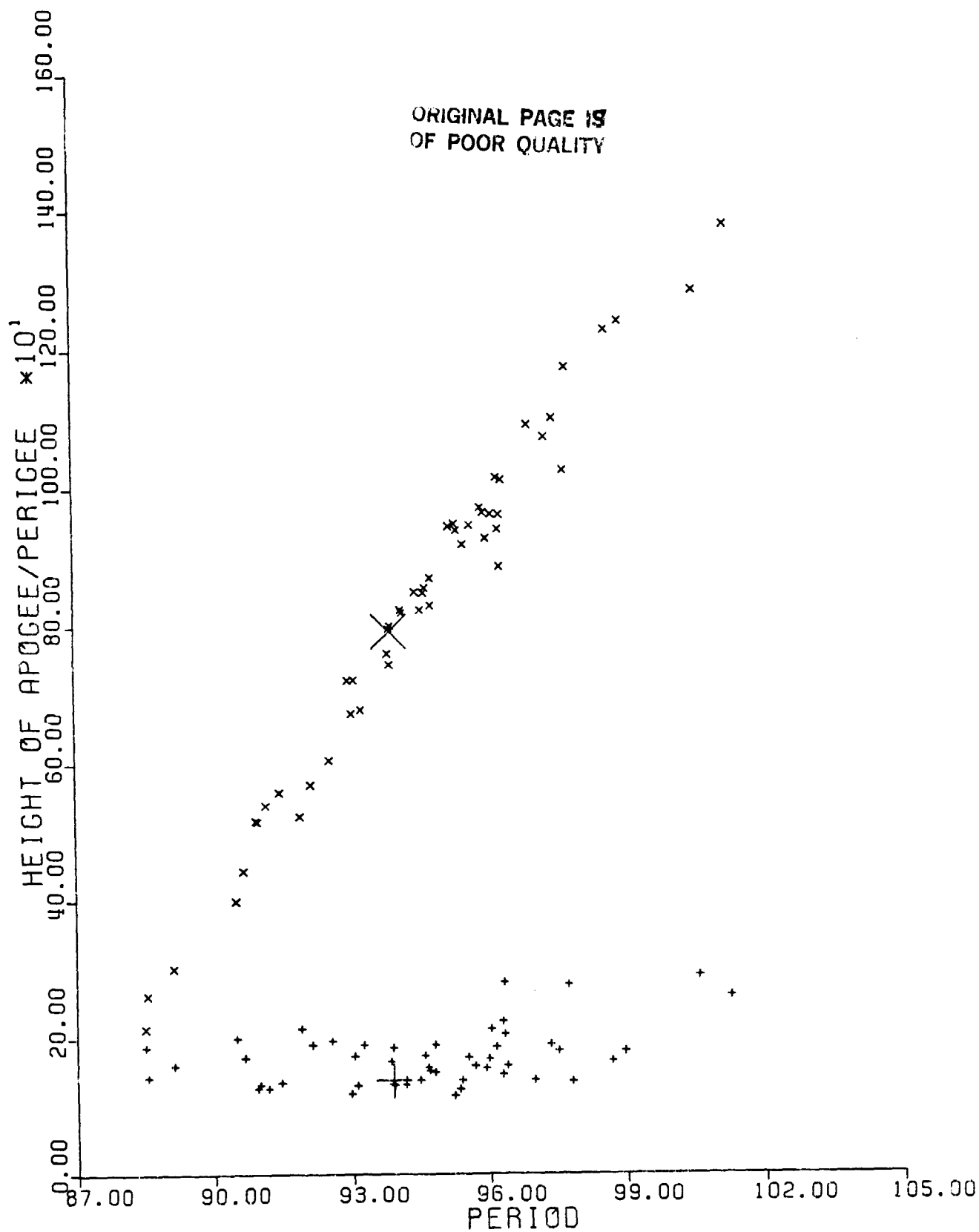
TRUE ANOMALY:

- COMMENTS:
- Alleged Fractional Orbit Bombardment System (FOBS) test.
 - This launch was between Cosmos 128 and 129 and was not acknowledged by the USSR.
 - Only debris was cataloged and satellite 2437 was the first piece cataloged.
 - No elements are in the archives for 2437. The orbit characteristics were taken from the initial element set for 2437 which is saved on file in the NORAD computational system.
 - General shape was cone-cylinder; length 6 m? dia. 1.5 m?
 - Probably fragmented on first revolution.

CAUSE: Unknown

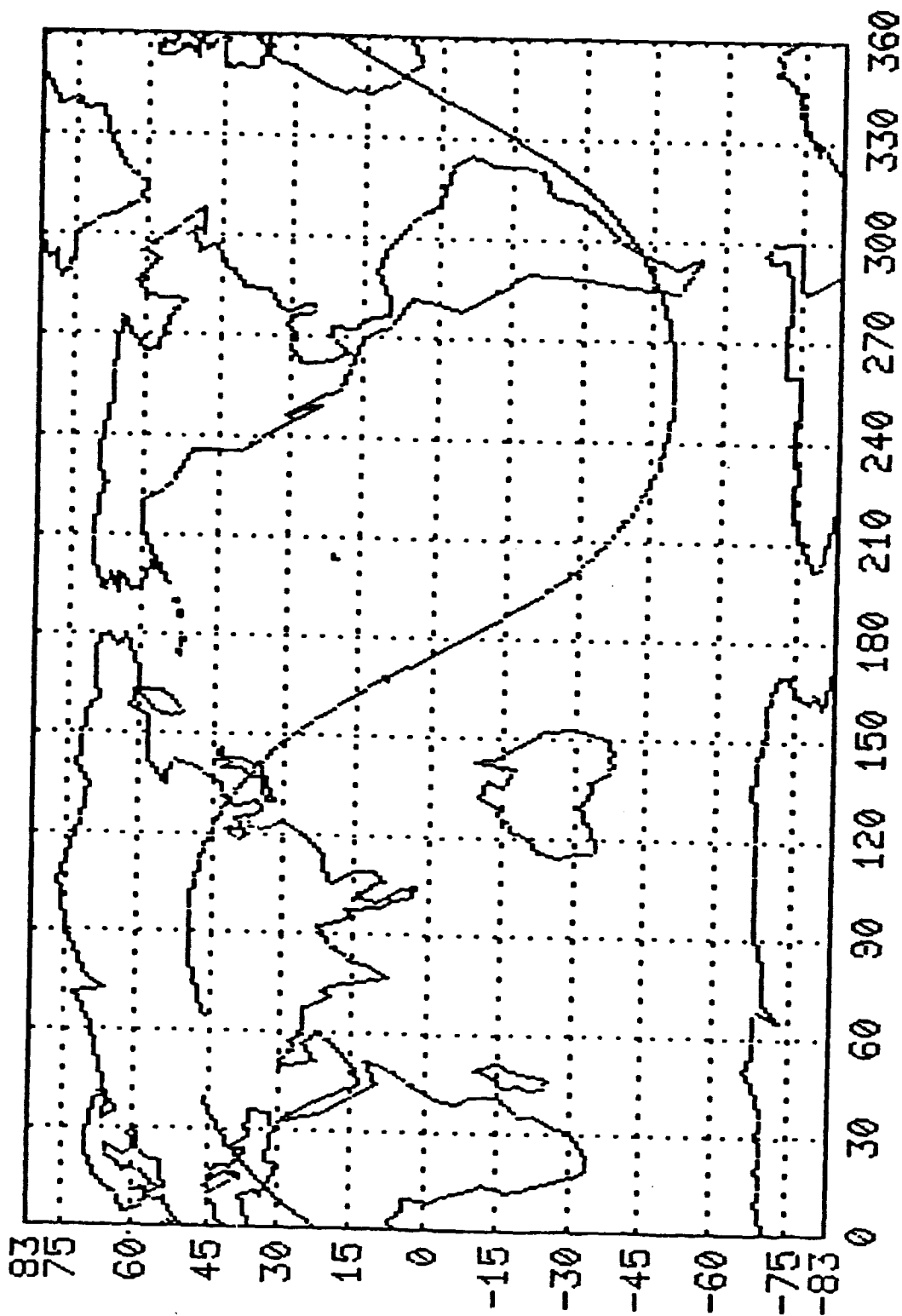
1966-88

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1966-88 FOBS

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1966-88 FOBS

1966-101

USSR/Unknown 2

2536

LAUNCH DATE: 2.03 Nov 1966

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 2 Nov 1966 (DAY 306)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 40

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 49.7°

APOGEE: 651 km

PERIGEE: 188 km

PERIOD: 92.9 min

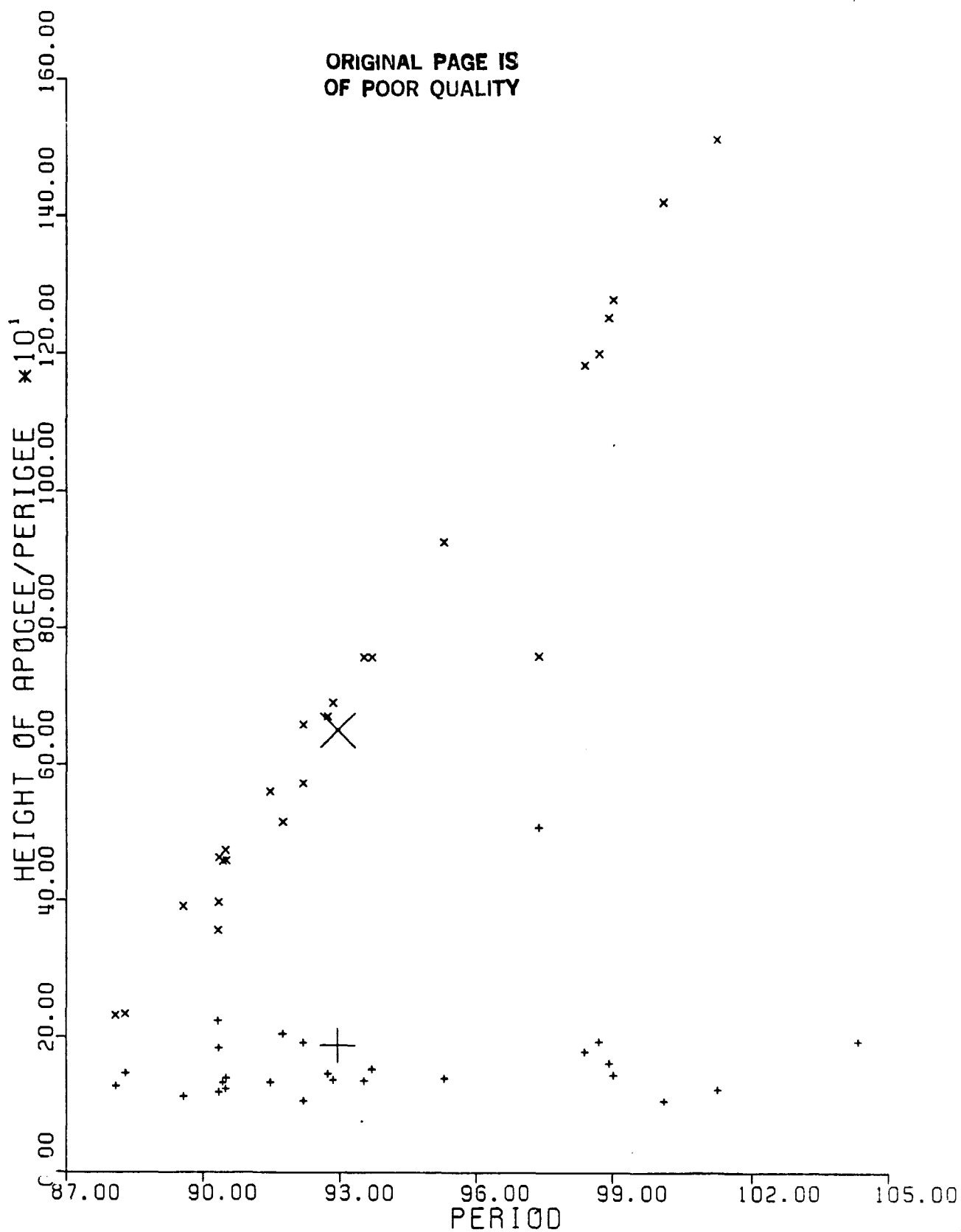
TRUE ANOMALY:

- COMMENTS:
- Alleged Functional Orbit Bombardment System (FOBS) test.
 - Only debris cataloged.
 - Satellite 2536 is the first piece of debris cataloged.
 - No elements are in the archives for 2536. The orbit characteristics were taken from the initial element set for 2536 which is saved on file in the NORAD computational system.
 - This launch was not acknowledged by the USSR.
 - General shape was cone-cylinder; length 6 m?; dia. 1.5 m?
 - Probably fragmented on first revolution.

CAUSE: Unknown

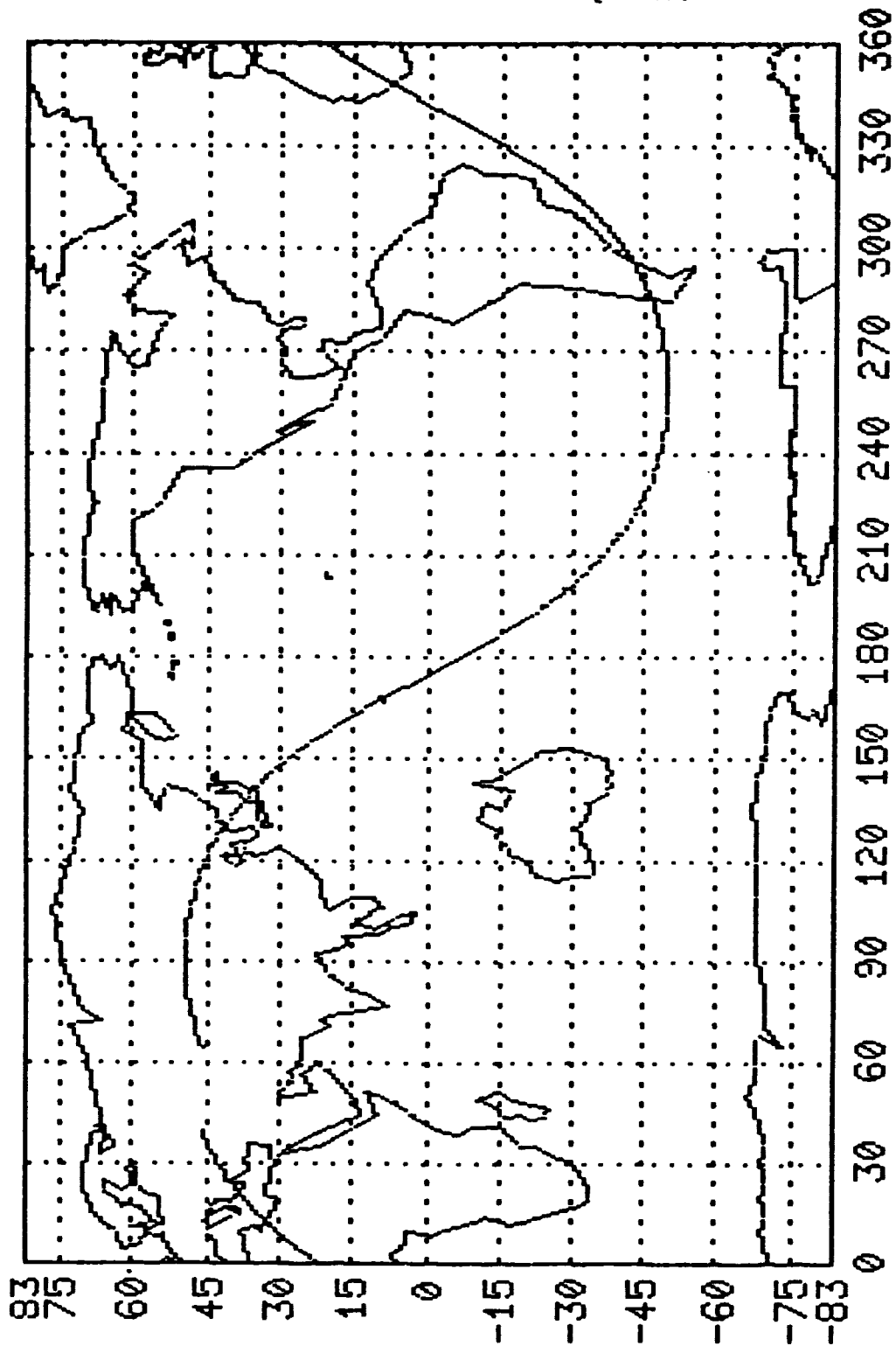
1966-101

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1966-101 FOBS

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1966-101 FOBS

1967-01

INTELSAT 2-F2 ROCKET

2640

LAUNCH DATE: 11.45 Jan 1967

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE:

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 23

PIECES STILL IN ORBIT (1 JAN 84): 4

ORBIT CHARACTERISTICS:

INCLINATION: 28.73°

APOGEE: 589 km

PERIGEE: 253 km

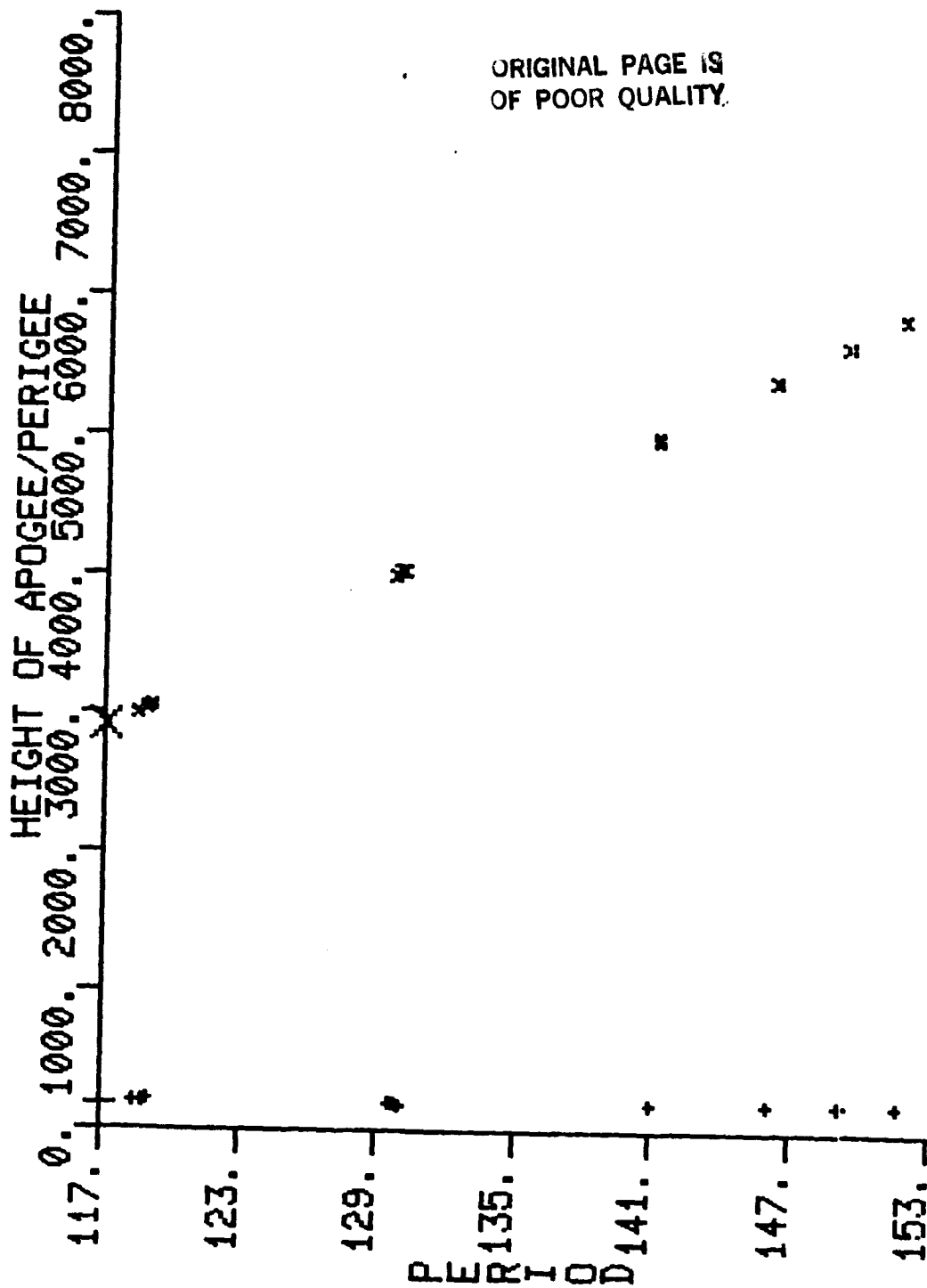
PERIOD: 93.6 min

TRUE ANOMALY:

- COMMENTS:
- Due to the low inclination of this launch and severe sensor limitations on low inclination orbits information on this event is sparse. Inconsistent observation of debris in the region between 2,800 and 6,000 km was experienced. Attempts to maintain elements on this debris were largely unsuccessful.
 - The identification of this debris with this launch is provisional.
 - Orbit characteristics developed from element set #1 on satellite 2640. However, the characteristics of the orbits of the debris indicates the event most likely occurred during a transfer maneuver.
 - Insufficient data is available to determine time and location of the event for satellite 2640.
 - Launch vehicle was a thrust augmented Delta (TAD). Payload was placed in planed orbit.

CAUSE: Unknown.

1967-01



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INTELSAT 2-F2 ROCKET

COMMENTS: • Insufficient data is available to show the applicable
ground track for satellite 2640, Intelsat 2-F2 rocket.

1967-01

1968-90

COSMOS 248

3503

LAUNCH DATE: 19.18 Oct 1968

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 1 Nov 1968 (DAY 306)

TIME: 041205.7 GMT

LOCATION: 55 N/104 E

ALTITUDE: 542 km

PIECES CATALOGED (1 JAN 84): 4

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 62.25°

APOGEE: 543 km

PERIGEE: 473 km

PERIOD: 94.8 min

TRUE ANOMALY: 172°

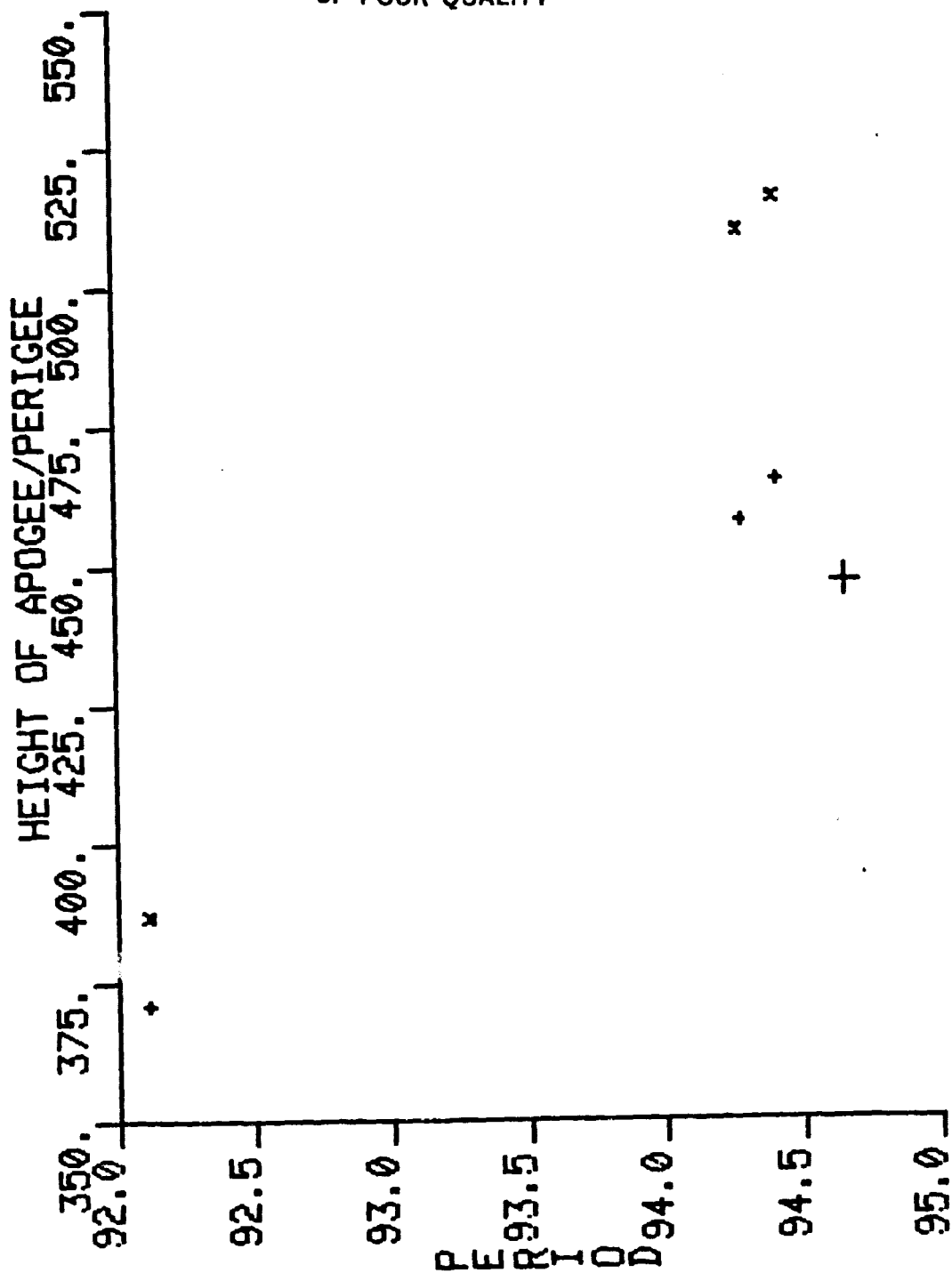
COMMENT:

- Alleged anti-satellite test target.
- Orbit characteristics derived from element set #5 on satellite 3503, epoch 30 Oct 68.
- General shape was cylinder?; length 4 m? dia. 2 m?

CAUSE: Pieces detected after second alleged ASAT test which involved the interceptor, Kosmos 252. This is the only alleged Soviet ASAT target which has experienced fragmentation immediately after an alleged ASAT test.

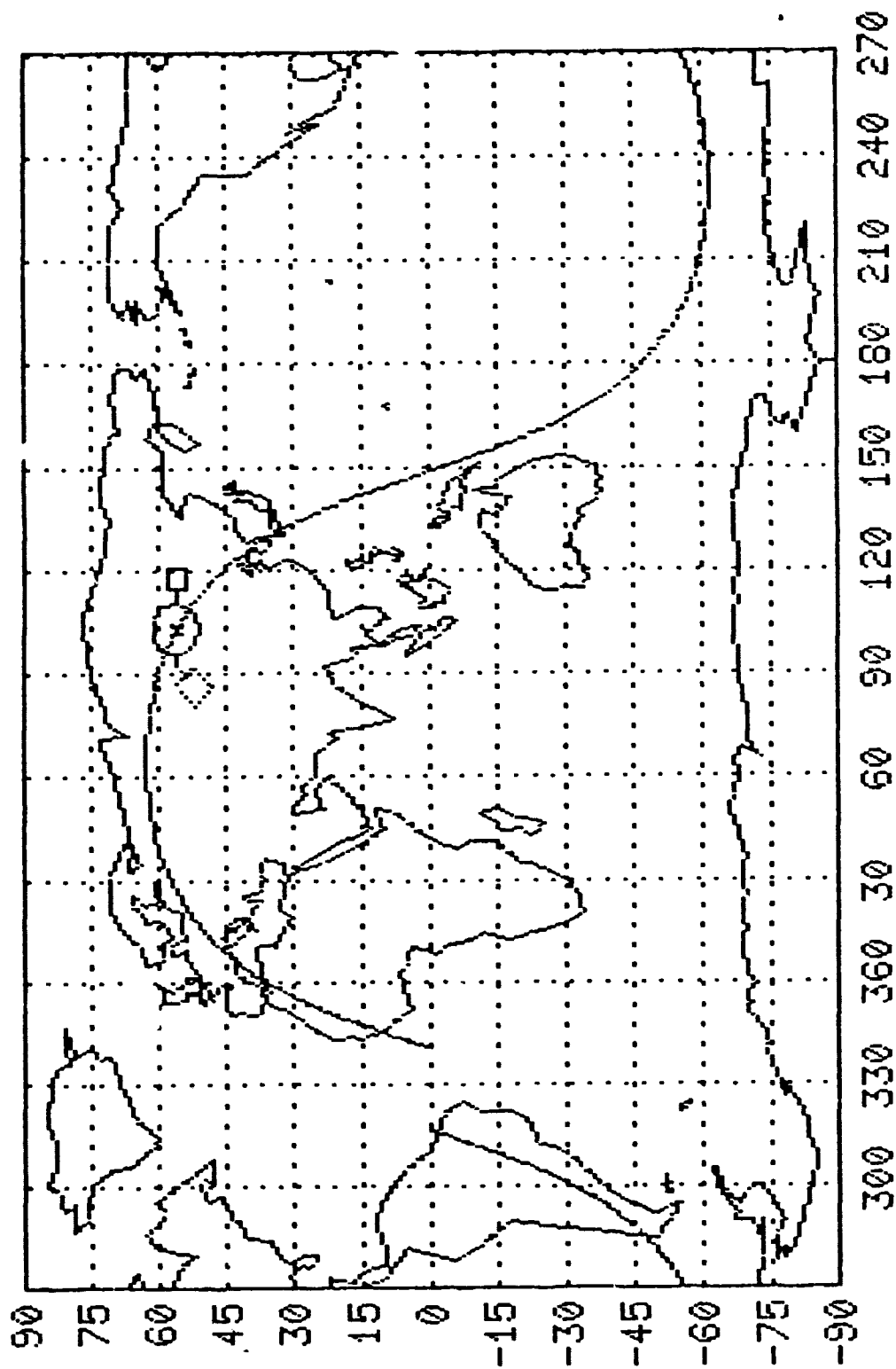
1968-90

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COSMOS 248

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COSMOS 248

1968-91

COSMOS 249

3504

LAUNCH DATE: 20.17 Oct 1968

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 20 Oct 1968 (DAY 294)

TIME: 142708.9 GMT

LOCATION: 57 S/181 E

ALTITUDE: 1994 km

PIECES CATALOGED (1 JAN 84): 91

PIECES STILL IN ORBIT (1 JAN 84): 55

ORBIT CHARACTERISTICS:

INCLINATION: 62.33°

APOGEE: 2159 km

PERIGEE: 496 km

PERIOD: 112.2 min

TRUE ANOMALY: 214°

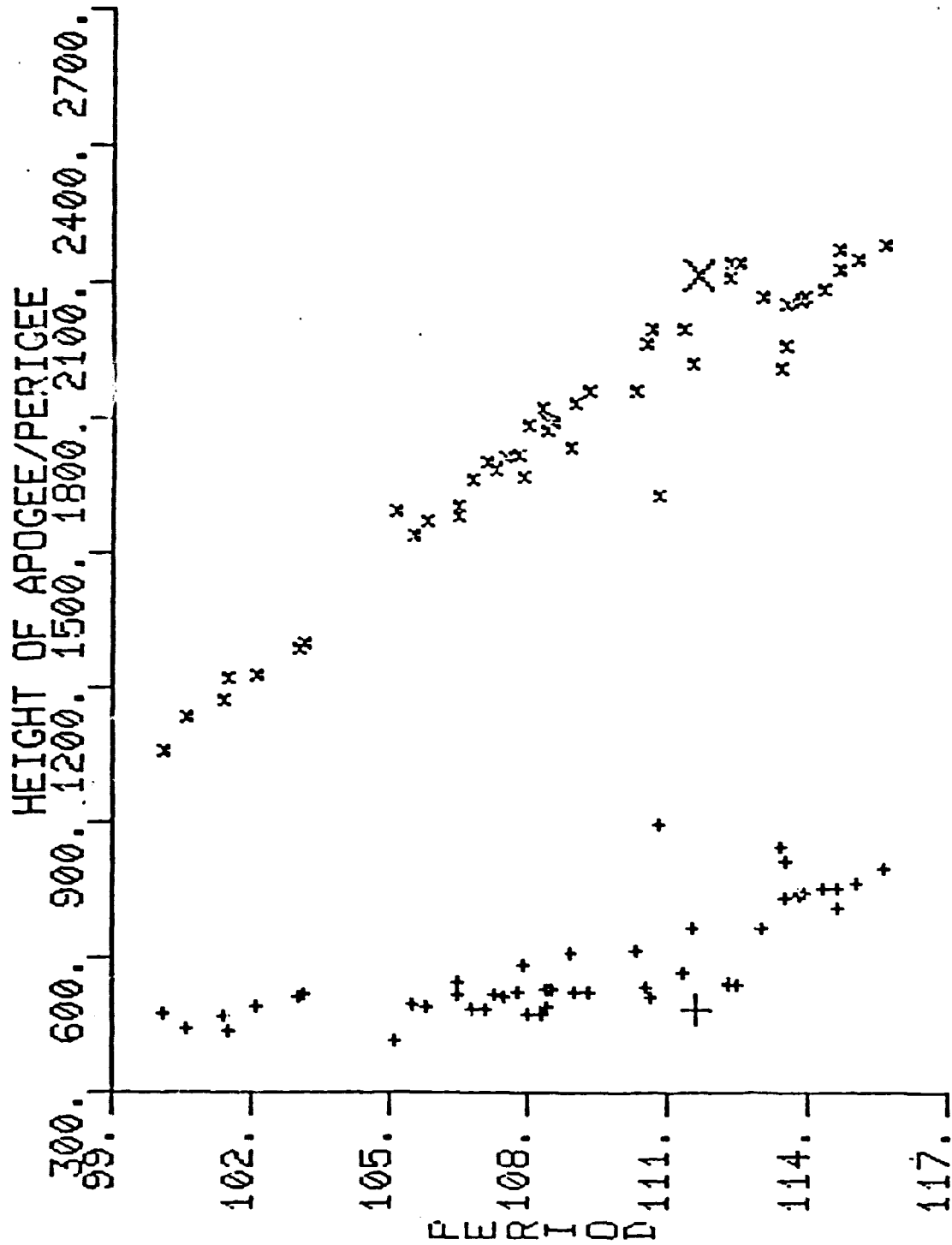
COMMENTS:

- General shape was cylinder?; length 4 m?; dia. 1.5 m?
- This was the 1st alleged USSR ASAT test.
- The distribution of debris suggests 2 separate fragmentation events.
- The break-up events did not occur near the target satellite (Kosmos 248).

CAUSE: Planned fragmentation as part of an alleged USSR ASAT test.

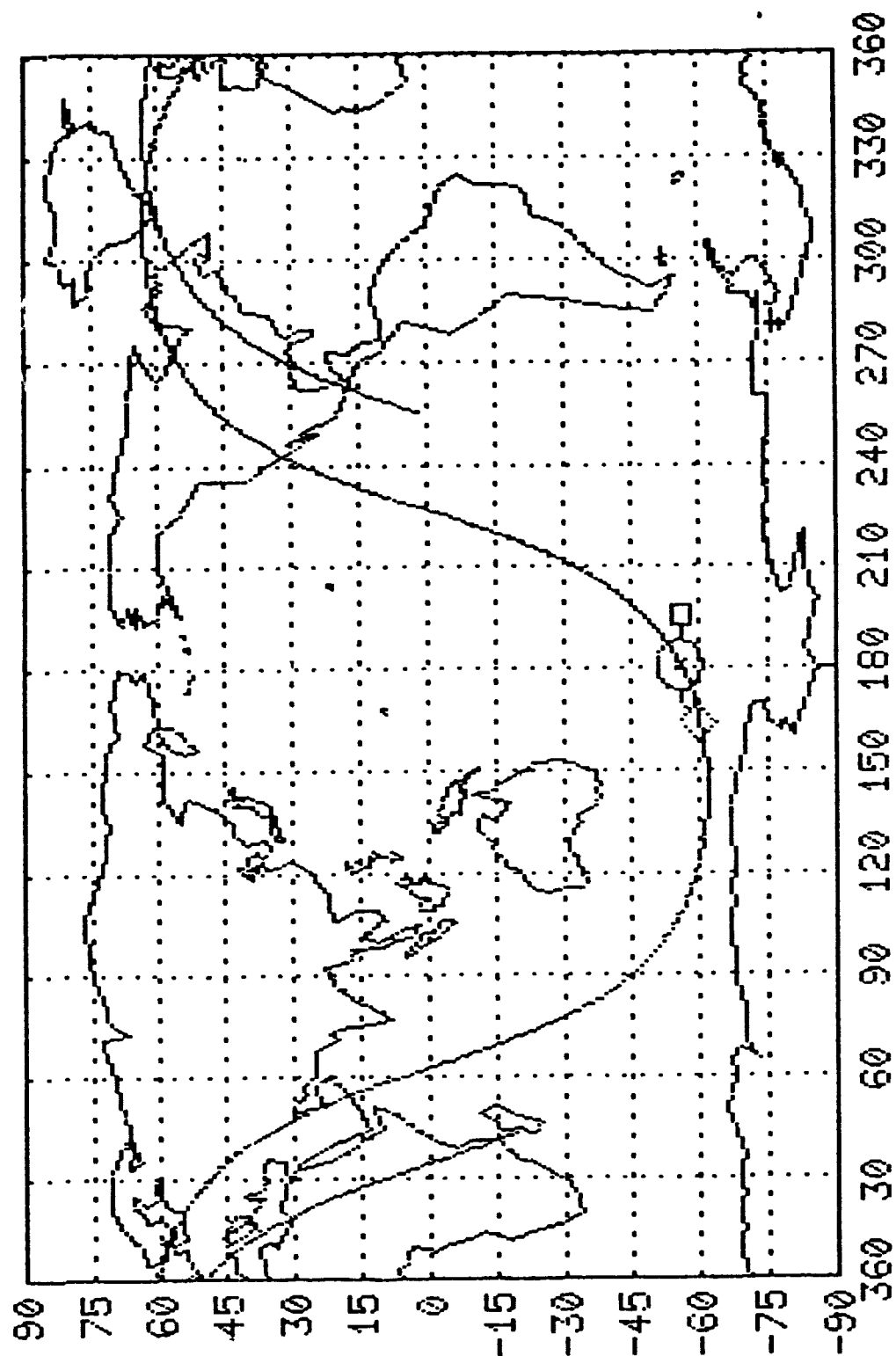
1968-91

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COSMOS 249

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COSMOS 249

1968-97

COSMOS 252

3530

LAUNCH DATE: 1.02 Nov 1968

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 1 Nov 1968 (DAY 306)

TIME: 040159.3 GMT

LOCATION: 58 N/34 E

ALTITUDE: 534 km

PIECES CATALOGED (1 JAN 84): 122

PIECES STILL IN ORBIT (1 JAN 84): 55

ORBIT CHARACTERISTICS:

INCLINATION: 62.34°

APOGEE: 2139 km

PERIGEE: 534 km

PERIOD: 112.4 min

TRUE ANOMALY: 360°

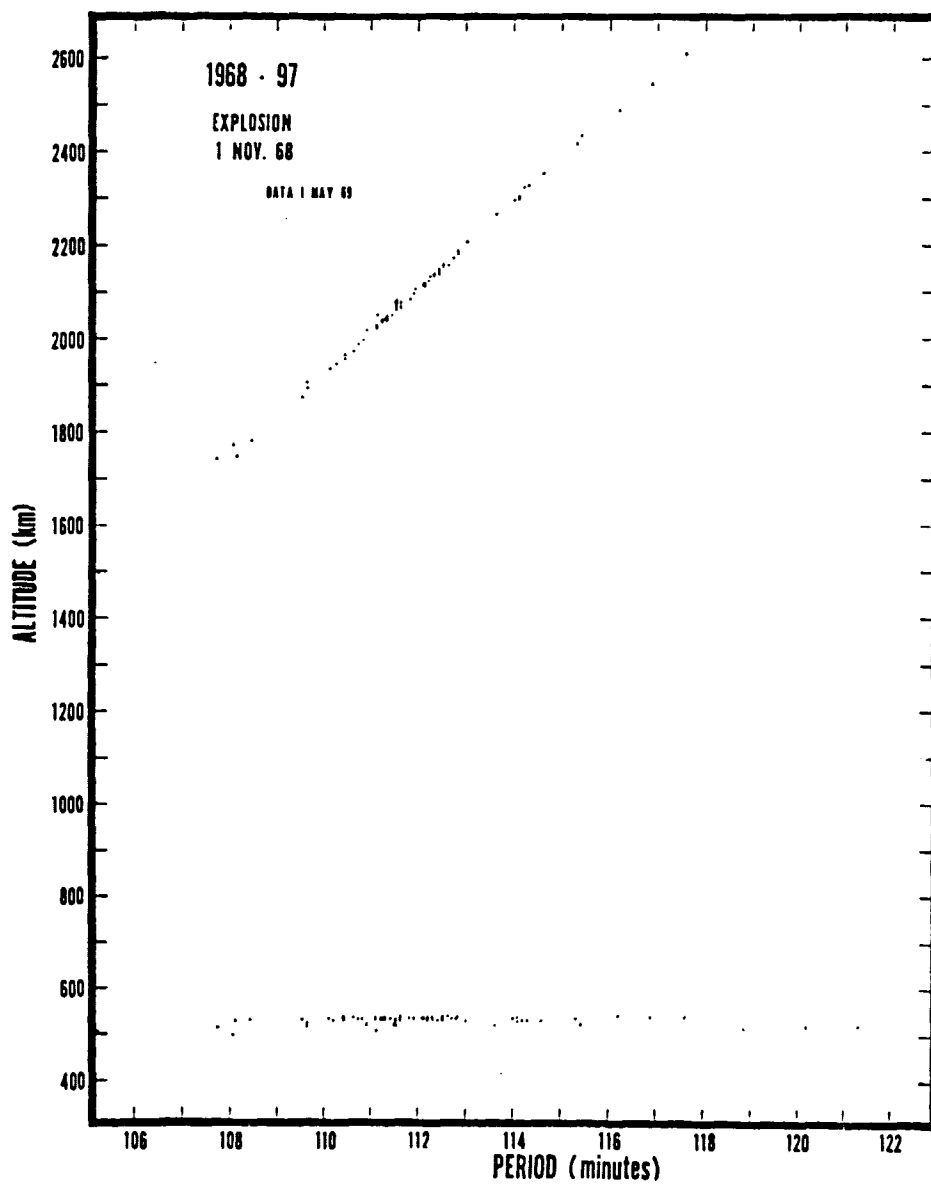
COMMENTS: • Alleged 2nd USSR ASAT test.

- Orbit data derived from element set #2 satellite 3530.
- General shape was cylinder?; length 4 m.?; dia. 2 m?
- Break-up occurred at perigee in the vicinity of the target satellite (Kosmos 248).

CAUSE: Planned fragmentation as part of an alleged USSR ASAT test.

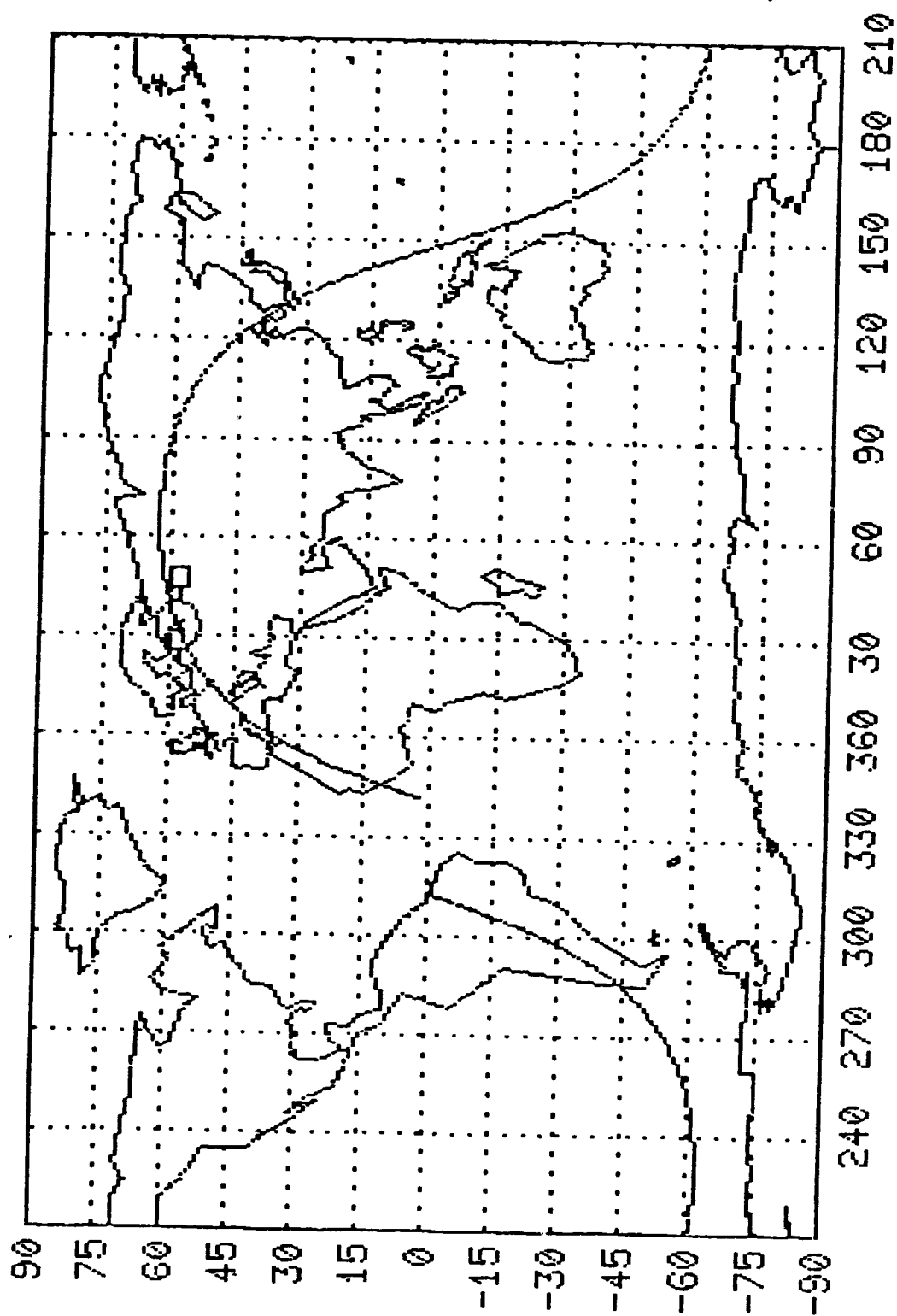
1968-97

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COSMOS 252

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COSMOS 252

1969-29

METEOR 1/ROCKET

3836

LAUNCH DATE: 26.52 Mar 1969

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 28 Mar 1969 (DAY 87)

TIME: 184431.52

LOCATION: 59 N/91 E

ALTITUDE: 554 km

PIECES CATALOGED (1 JAN 84): 36

PIECES STILL IN ORBIT (1 JAN 84): 2

ORBIT CHARACTERISTICS:

INCLINATION: 81.17°

APOGEE: 851 km

PERIGEE: 462 km

PERIOD: 97.9 min

TRUE ANOMALY: 300°

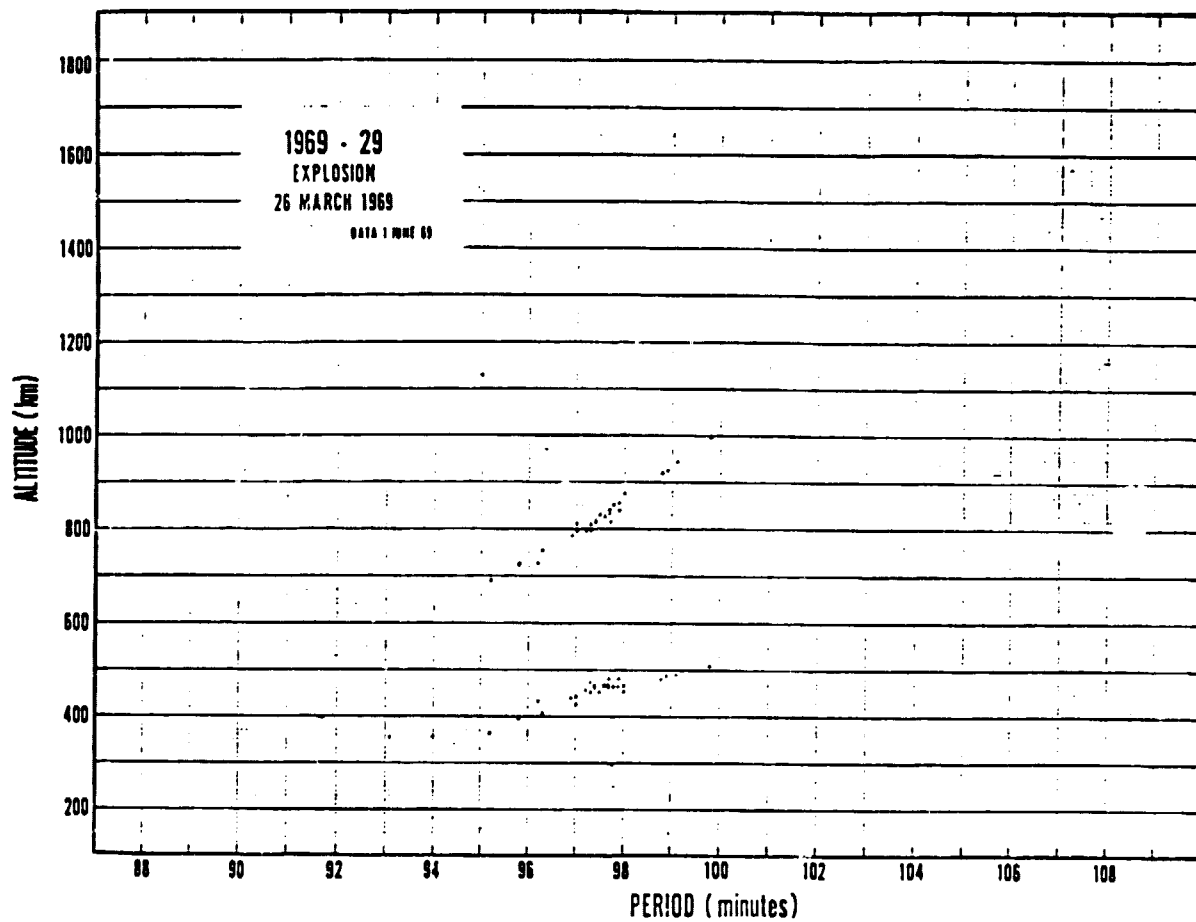
COMMENTS: • General shape was cylinder; length 3.8 m; dia. 2.6 m; weight 1440 kg.

• Orbit data derived from element set #2 (Epoch = 69087.213) of payload satellite 3835. (Identity of payload and rocket had been switched in element data).

CAUSE: Unknown

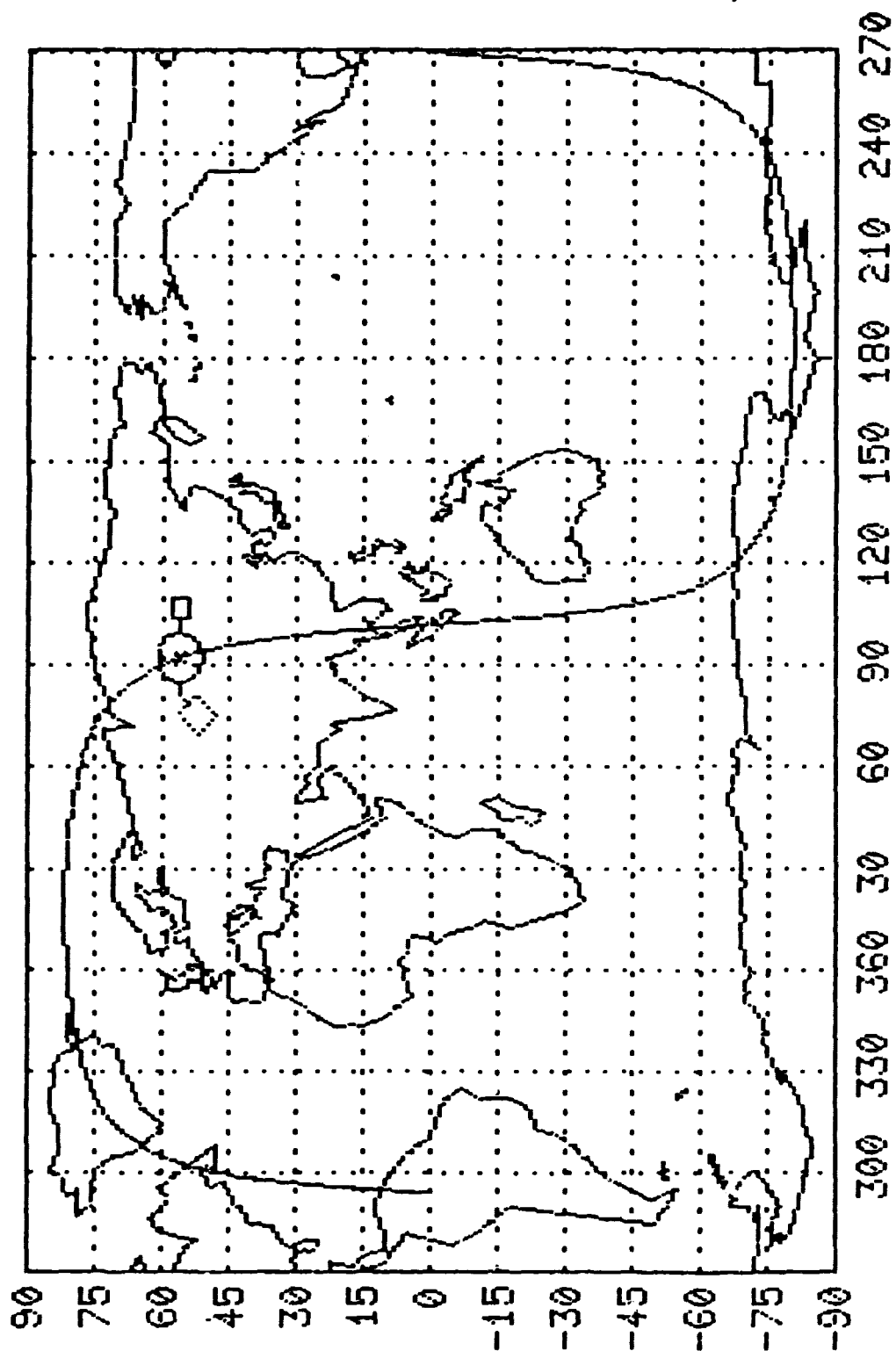
1969-29

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METEOR 1/ROCKET

ORIGINAL PAGE 19
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METEOR 1 R/B

1969-64

INTELSAT 3-F5 R/B

4052

LAUNCH DATE: 26.09 Jul 1969

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 26 Jul 1969 (DAY 207)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 24

PIECES STILL IN ORBIT (1 JAN 84): 4

ORBIT CHARACTERISTICS:

INCLINATION: 30.37°

APOGEE: 5445 km

PERIGEE: 271 km

PERIOD: 147.2 min

TRUE ANOMALY:

COMMENTS:

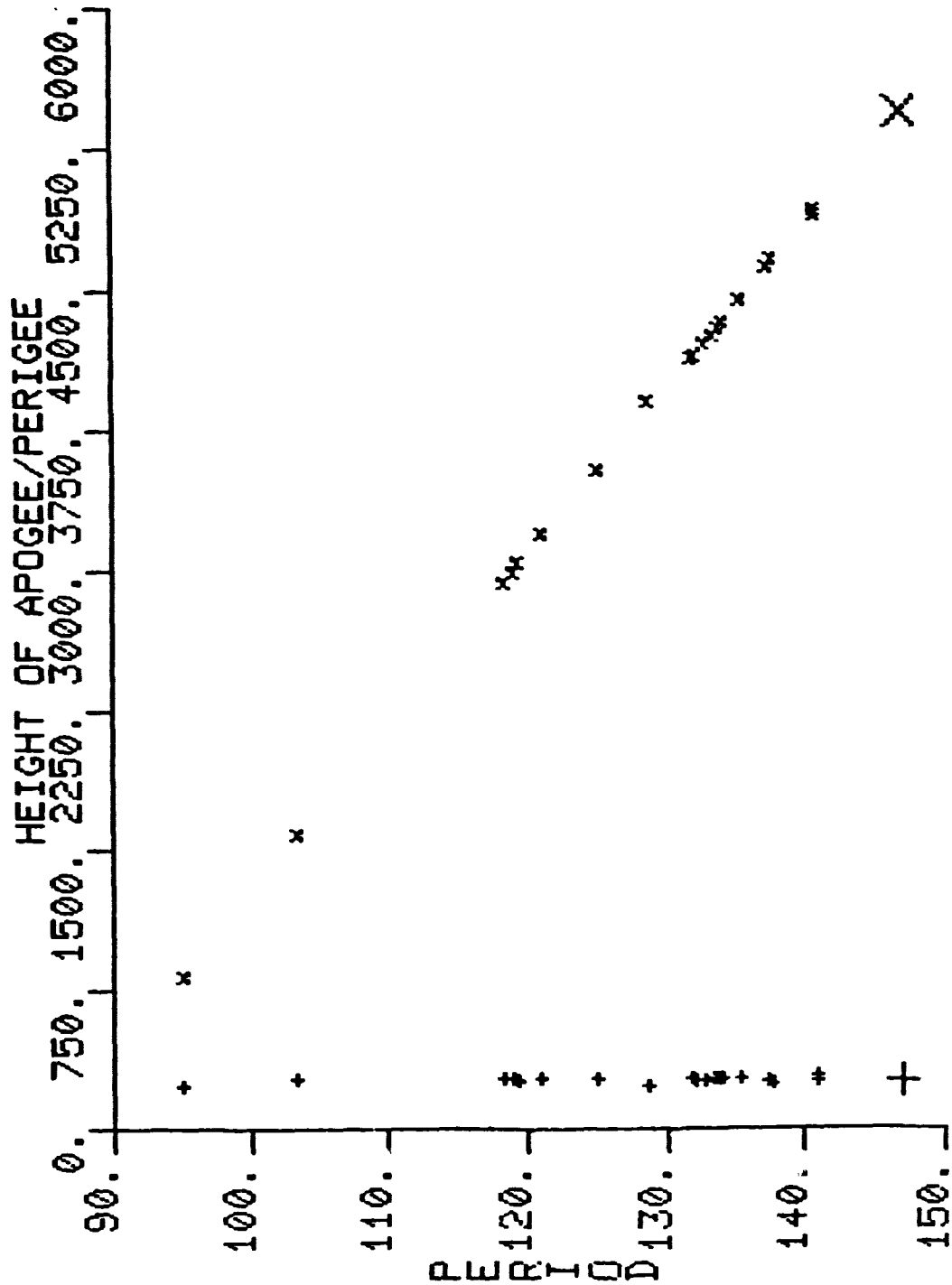
- Orbit data derived from element set #1 on satellite 4052.
- The launch vehicle was a LTTA-Delta rocket.
- General shape was sphere-cone; length 1.32 m; dia. 94 m; weight 66 kg.
- This launch attained orbit, however, the payload was unusable because a 3rd stage malfunction placed it into an incorrect orbit.
- Four cataloged debris not from this event; satellites 5309, 13913, 13914 and 13915. They are not plotted on the following orbit distribution plot.

CAUSE: Unknown

1969-64

C-2

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INTELSAT 3-F5 R/B

COMMENTS: • Insufficient data to show applicable ground trace for
satellite 4052.

1969-64

1969-82

OPS 7613 R/B

4132

LAUNCH DATE: 30.57 Sep 1969

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 4 Oct 1969 (DAY 277)

TIME: 155309.2 GMT

LOCATION: 54 N/178 E

ALTITUDE: 919 km

PIECES CATALOGED (1 JAN 84): 241

PIECES STILL IN ORBIT (1 JAN 84): 123

ORBIT CHARACTERISTICS:

INCLINATION: 70.0°

APOGEE: 940 km

PERIGEE: 907 km

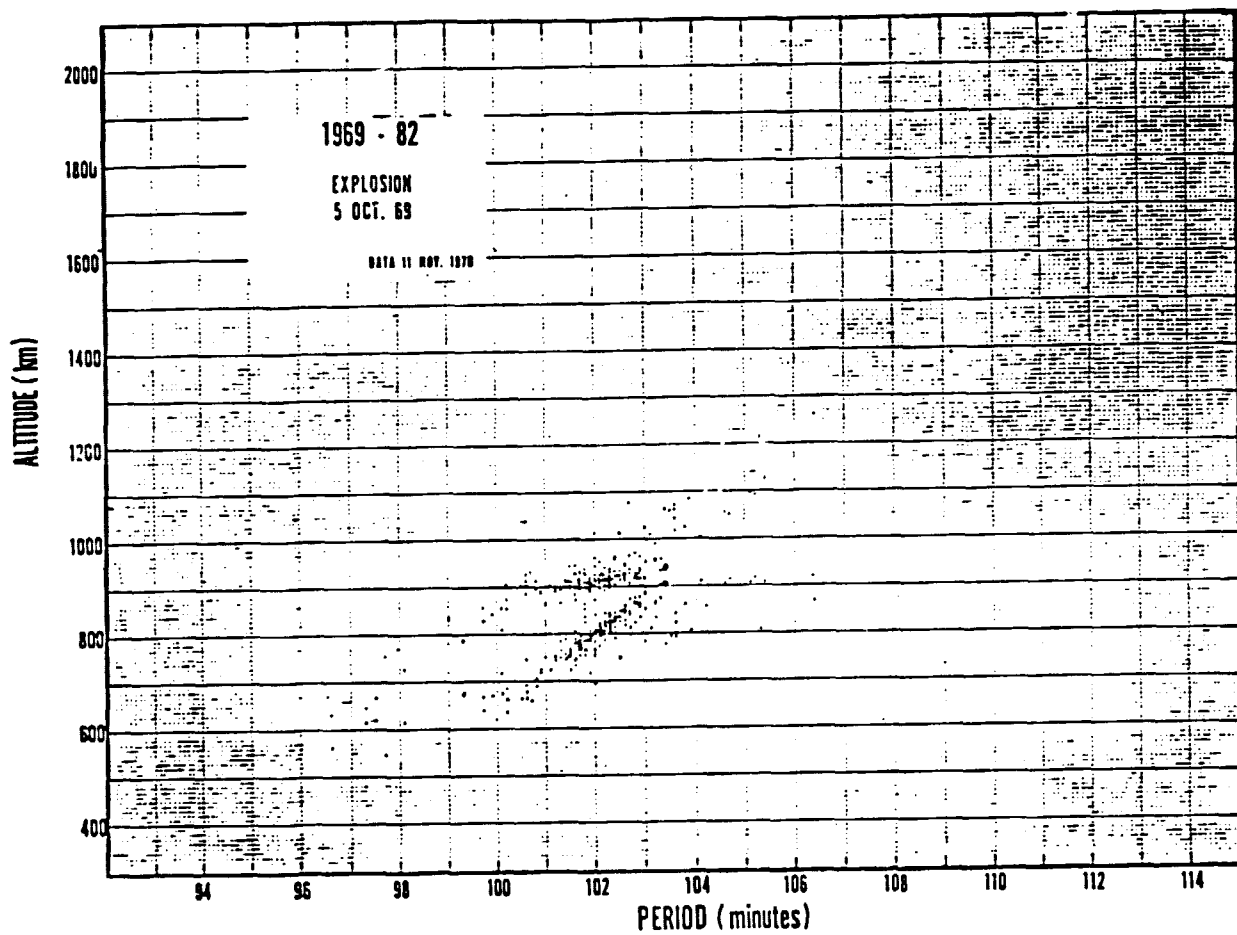
PERIOD: 103.4 min

TRUE ANOMALY: 11°

- COMMENTS:**
- Launched with Thorad-Agena D rocket. The rocket was not cataloged by NORAD for this launch because the rocket fragmented before its orbit could be developed.
 - NORAD cataloged the debris with a substitute parent: payload #9, Ops 7613, satellite 4132.
 - The orbital characteristics shown are from satellite 4132 and serve as an approximation of the unknown rocket orbit.
 - The ground trace was derived from the orbit of a large piece of debris and fits the rocket orbit at the point of fragmentation and approximates the actual rocket orbit for the remainder of the ground trace.

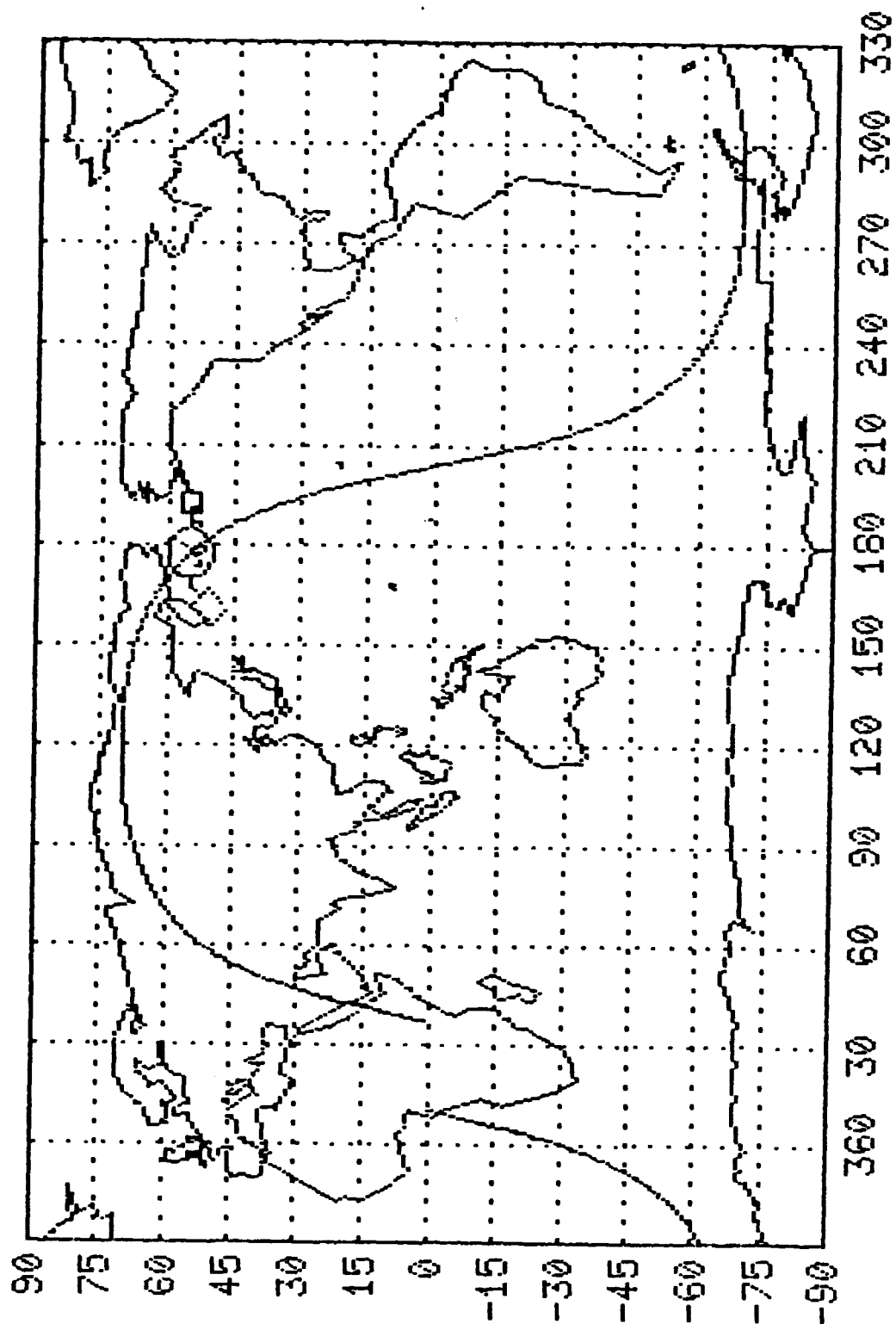
CAUSE: Unknown

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OPS 7613 R/B

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OPS 7613 R/B

1970-25

NIMBUS-4 R/B

4367

LAUNCH DATE: 8.35 Apr 1970

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 17 Oct 1970 (DAY 290)

TIME: 031717.0 GMT

LOCATION: 50 S/142 E

ALTITUDE: 1076 km

PIECES CATALOGED (1 JAN 84): 330

PIECES STILL IN ORBIT (1 JAN 84): 282

ORBIT CHARACTERISTICS:

INCLINATION: 99.79°

APOGEE: 1094 km

PERIGEE: 1051 km

PERIOD: 106.7 min

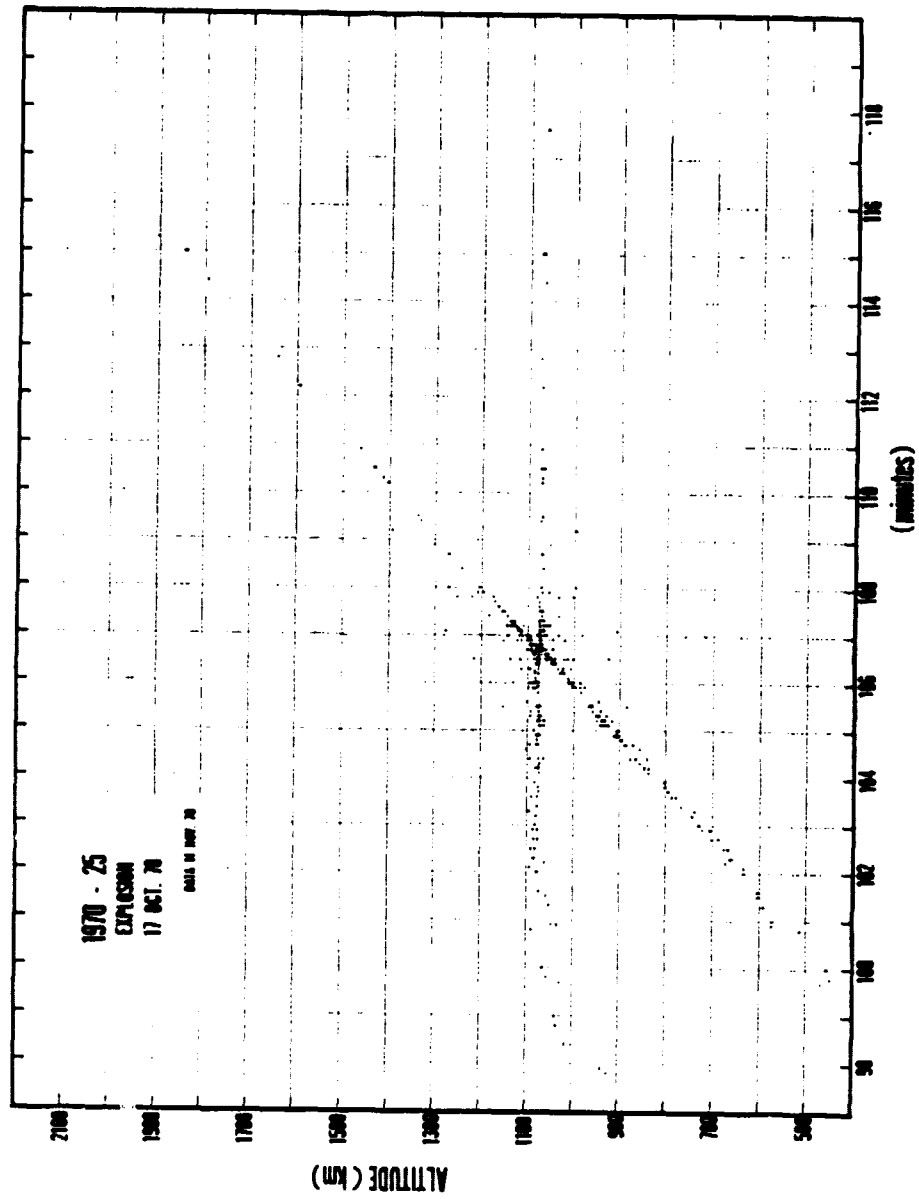
TRUE ANOMALY: 93°

COMMENTS:

- Launched with Thor-Agena D.
- General shape was cylinder; length 6 m; dia. 1.5 m; weight 700 kg?
- Orbit data derived from element set #966 for satellite 4367.

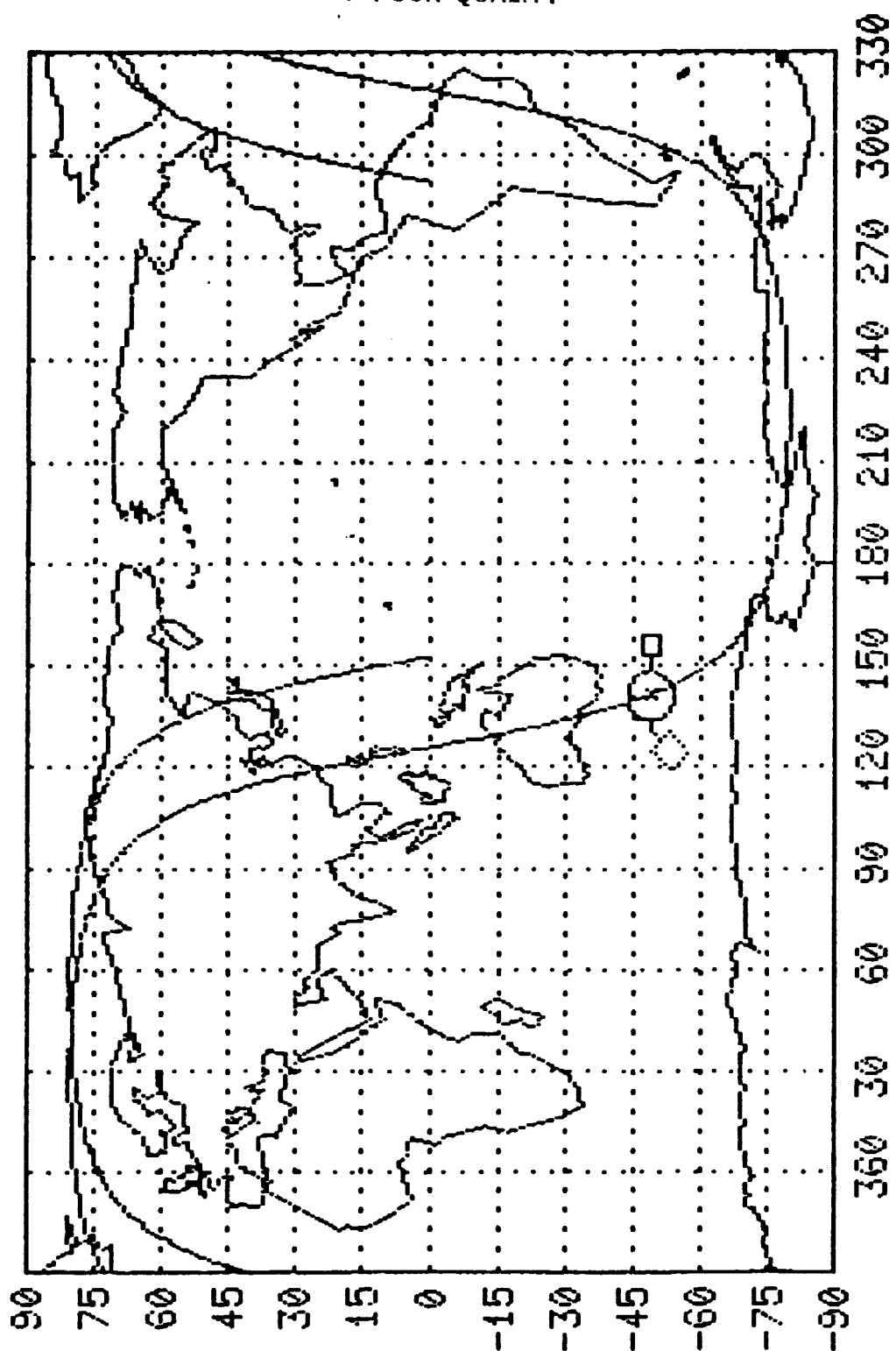
CAUSE: Unknown

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NIMBUS-4 R/B

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1970-89

.COMSOS 374

4594

LAUNCH DATE: 23.18 Oct 1970

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 23 Oct 1970 (DAY 296)

TIME: 151323.6 GMT

LOCATION: 22 S/217 E

ALTITUDE: 1197 km

PIECES CATALOGED (1 JAN 84): 92

PIECES STILL IN ORBIT (1 JAN 84): 44

ORBIT CHARACTERISTICS:

INCLINATION: 62.94

APOGEE: 2132 km

PERIGEE: 529 km

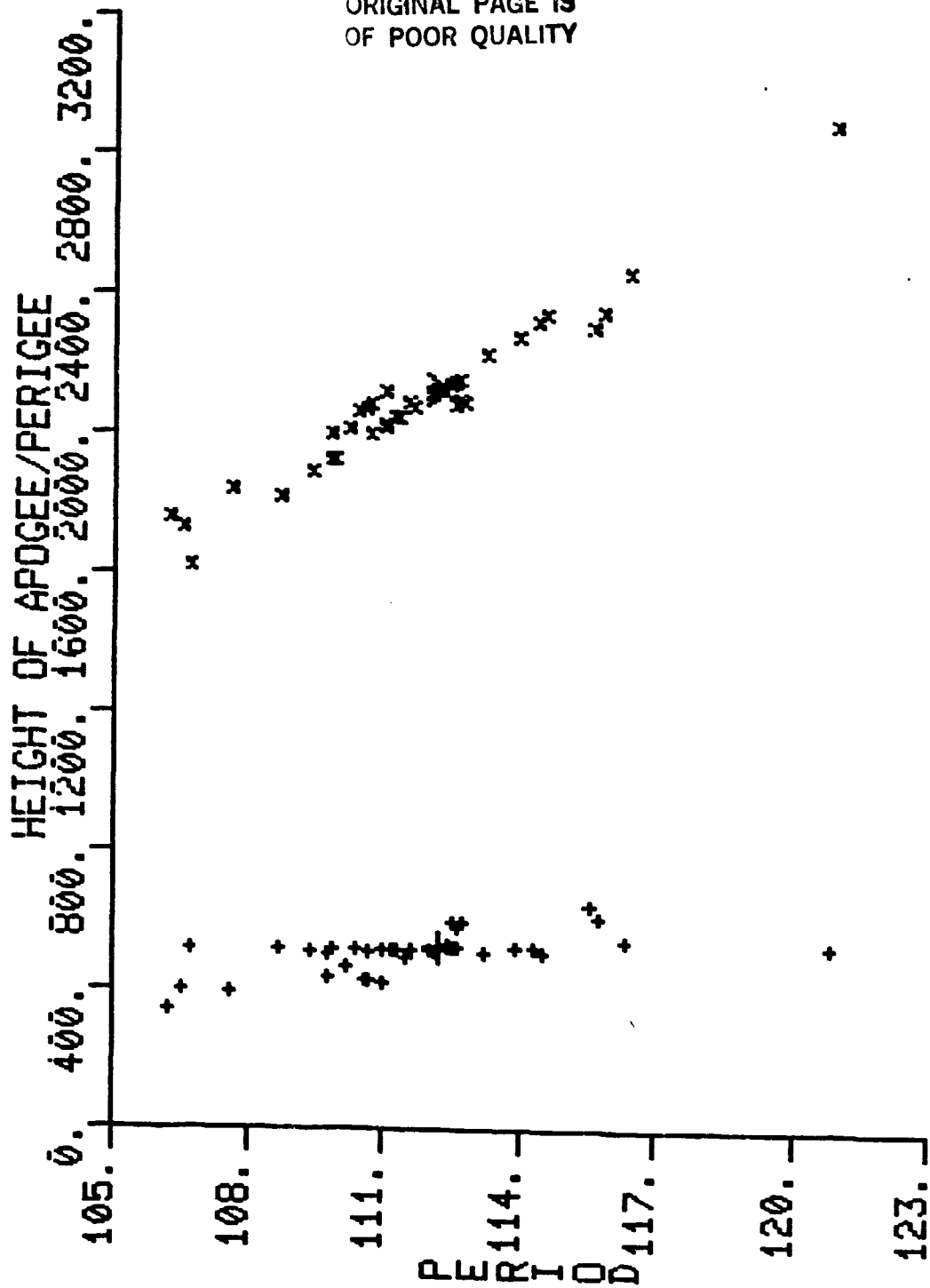
PERIOD: 112.3 min

TRUE ANOMALY: 273°

- COMMENTS:**
- Alleged Soviet ASAT test.
 - Orbit data derived from element set #2 for satellite 4594.
 - General shape was cylinder?; length 4 m?; dia. 2 m?
 - Break-up did not occur in the vicinity of the alleged target satellite (Kosmos 373).

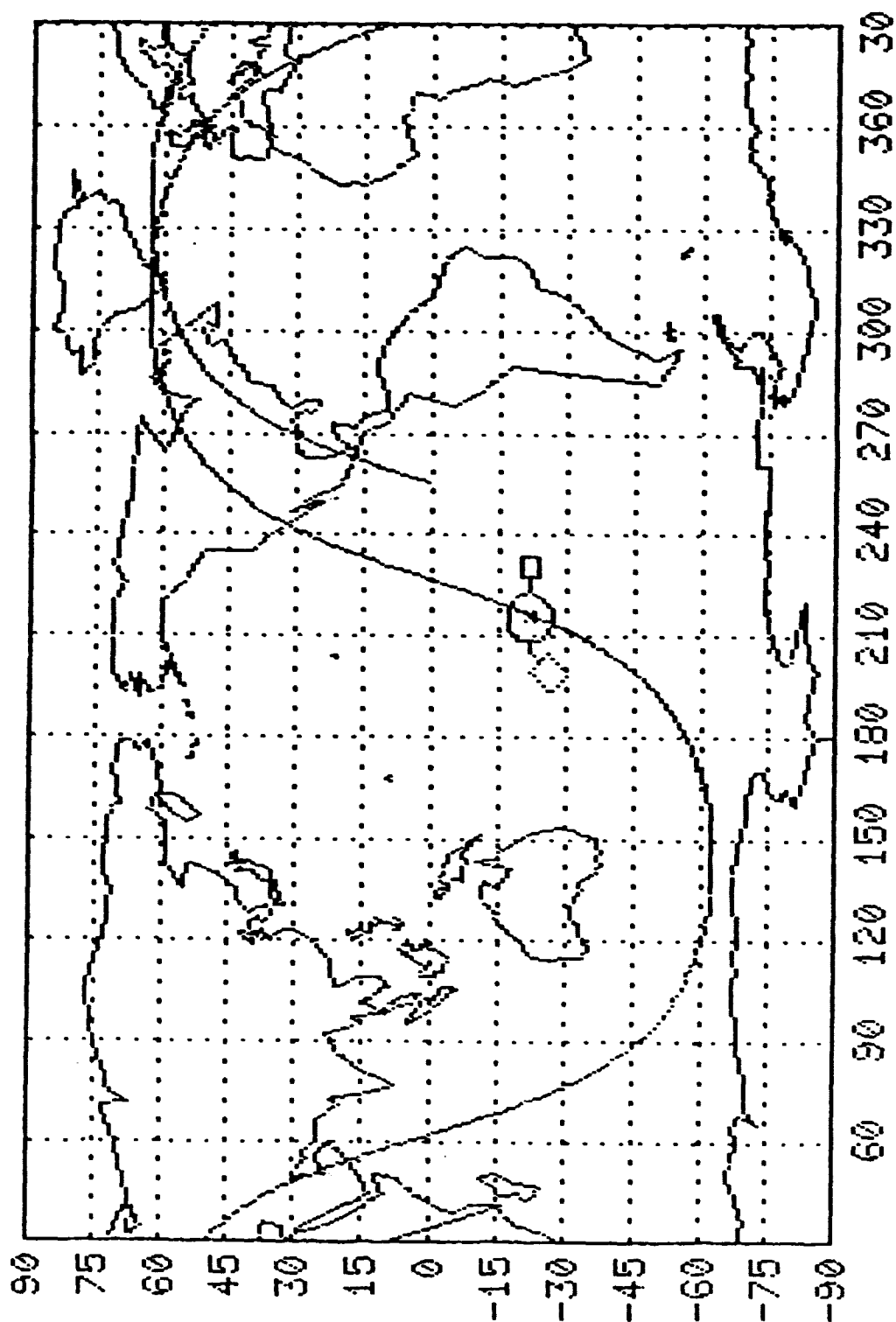
CAUSE: Planned fragmentation as part of an alleged USSR ASAT test.

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COSMOS 374

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COSMOS 374

1970-91

COSMOS 375

4598

LAUNCH DATE: 30.09 Oct 1970

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 30 Oct 1970 (DAY 303)

TIME: 060003.77 GMT

LOCATION: 54 N/23 E

ALTITUDE: 565 km

PIECES CATALOGED (1 JAN 84): 41

PIECES STILL IN ORBIT (1 JAN 84): 31

ORBIT CHARACTERISTICS:

INCLINATION: 62.83°

APOGEE: 2186 km

PERIGEE: 464 km

PERIOD: 112.1 min

TRUE ANOMALY: 359°

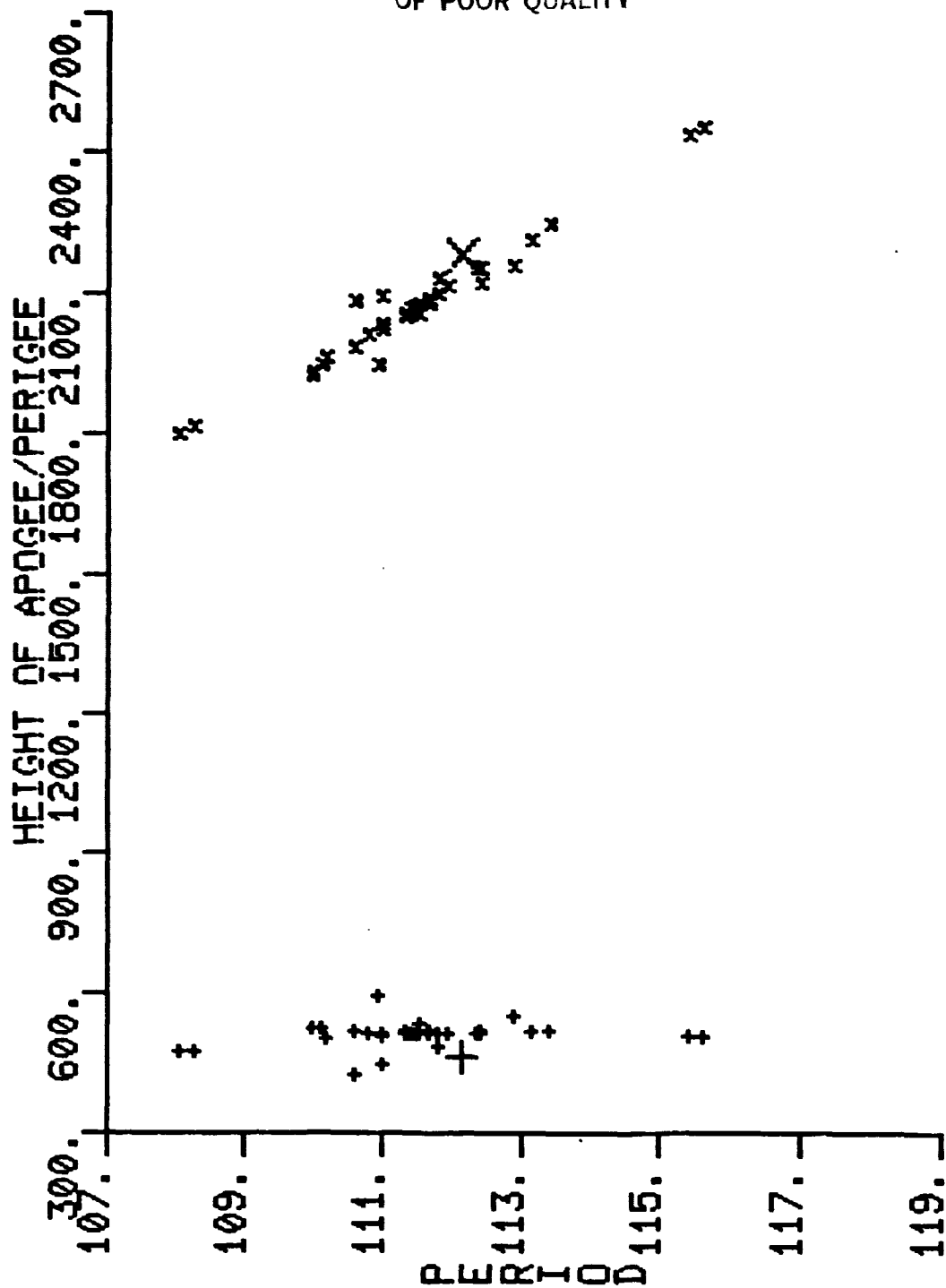
COMMENTS:

- Alleged Soviet ASAT test.
- Orbit data derived from element set #2 for satellite 4598.
- General shape was cylinder?; length 4 m?; dai. 2 m?
- Break-up occurred in the vicinity of the alleged target satellite (Kosmos 373).

CAUSE: Planned fragmentation as part of an alleged USSR ASAT test.

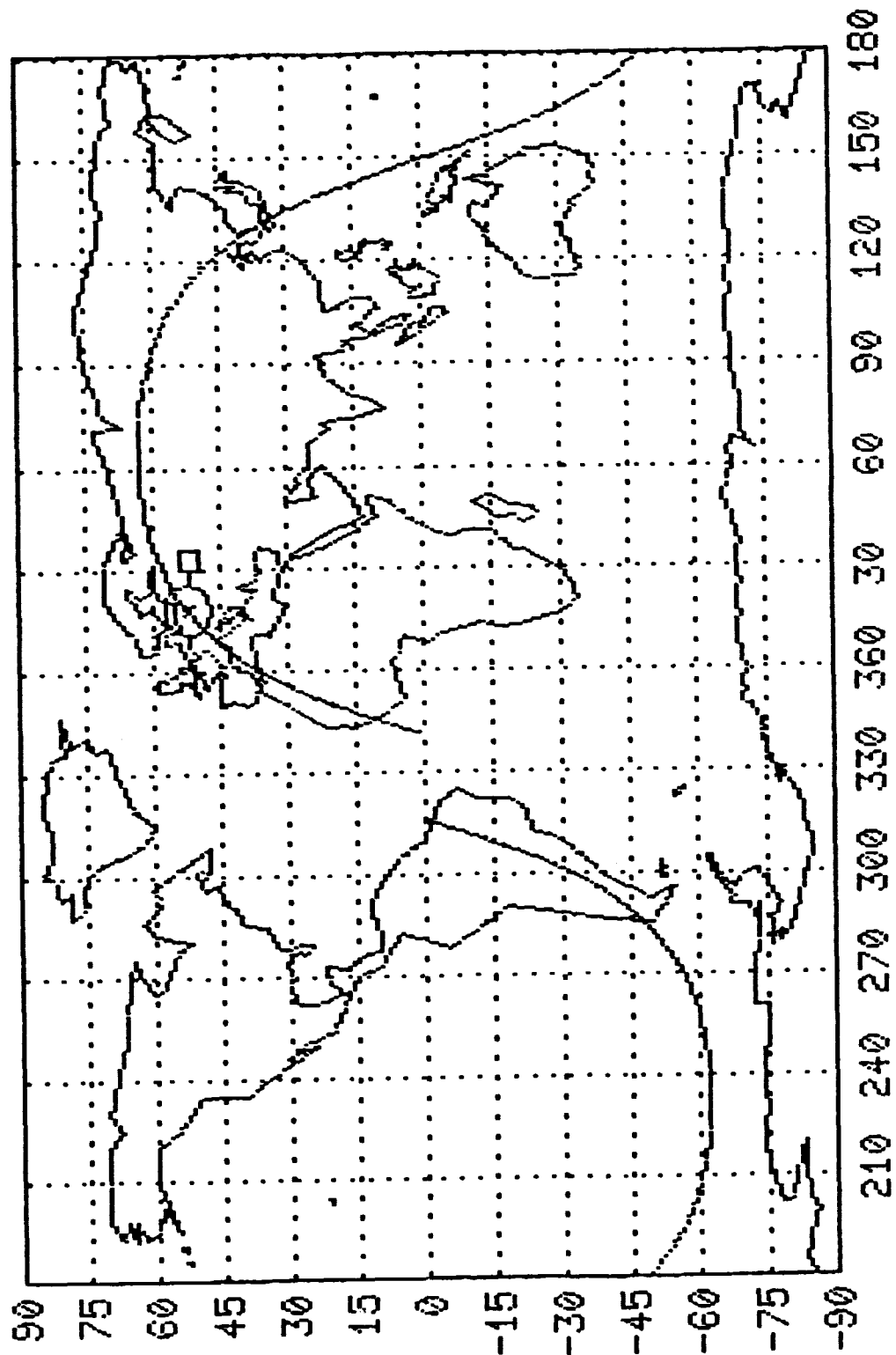
1970-91

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COSMOS 375

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COSMOS 375

1971-15

COSMOS 397

4964

LAUNCH DATE: 25.47 Feb 1971

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 25 Feb 1971 (DAY 56)

TIME: 143039.2 GMT

LOCATION: 54 N/21 E

ALTITUDE: 587 km

PIECES CATALOGED (1 JAN 84): 88

PIECES STILL IN ORBIT (1 JAN 84): 73

ORBIT CHARACTERISTICS:

INCLINATION: 65.76°

APOGEE: 2,200 km

PERIGEE: 575 km

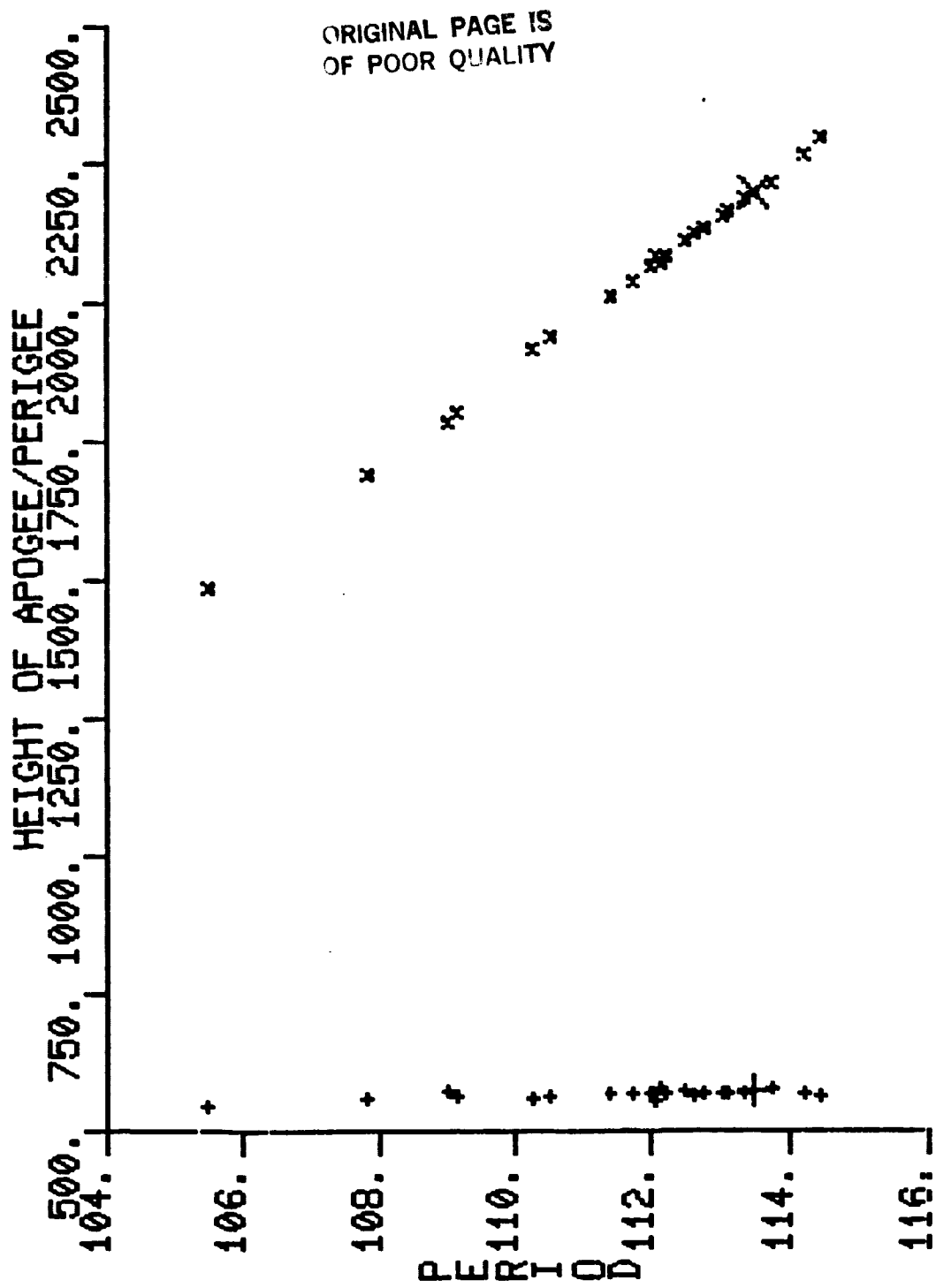
PERIOD: 113.5 min

TRUE ANOMALY: 11°

COMMENTS: • Alleged Soviet ASAT test.

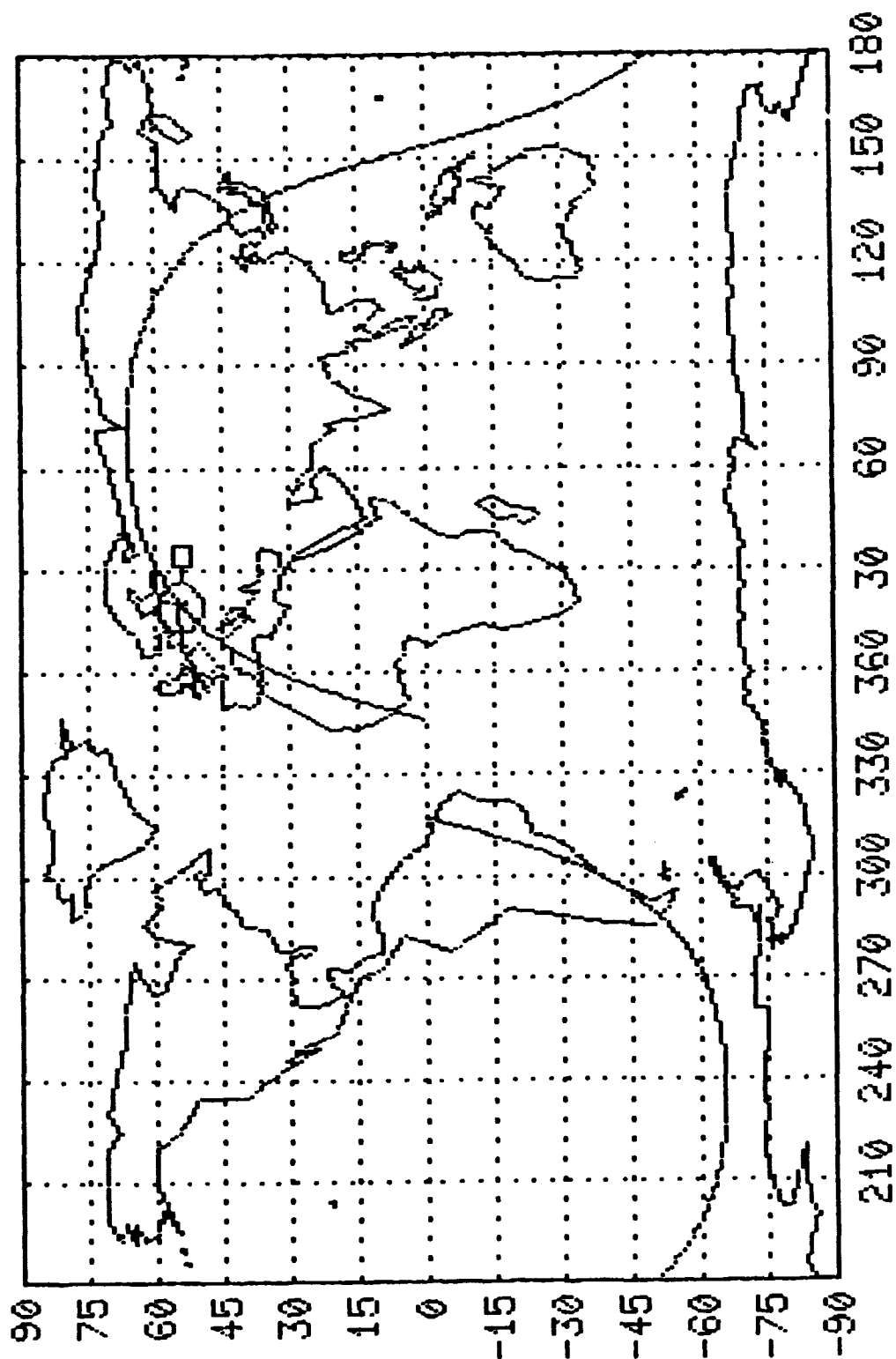
- General shape was cylinder; length 4 m?; dia. 2 m?
- Orbit data derived from element set #2 for satellite 4964.
- Break-up occurred in the vicinity of the alleged target satellite (Kosmos 394).

CAUSE: Planned fragmentation as part of an alleged USSR ASAT test.



COSMOS 397

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COSMOS 397

1971-106

COSMOS 462

5646

LAUNCH DATE: 3.55 Dec 1971

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 3 Dec 1971 (DAY 337)

TIME: 165102.2 GMT

LOCATION: 52 N/9 E

ALTITUDE: 231 km

PIECES CATALOGED (1 JAN 84): 27

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 65.88°

APOGEE: 1,654 km

PERIGEE: 231 km

PERIOD: 103.8 min

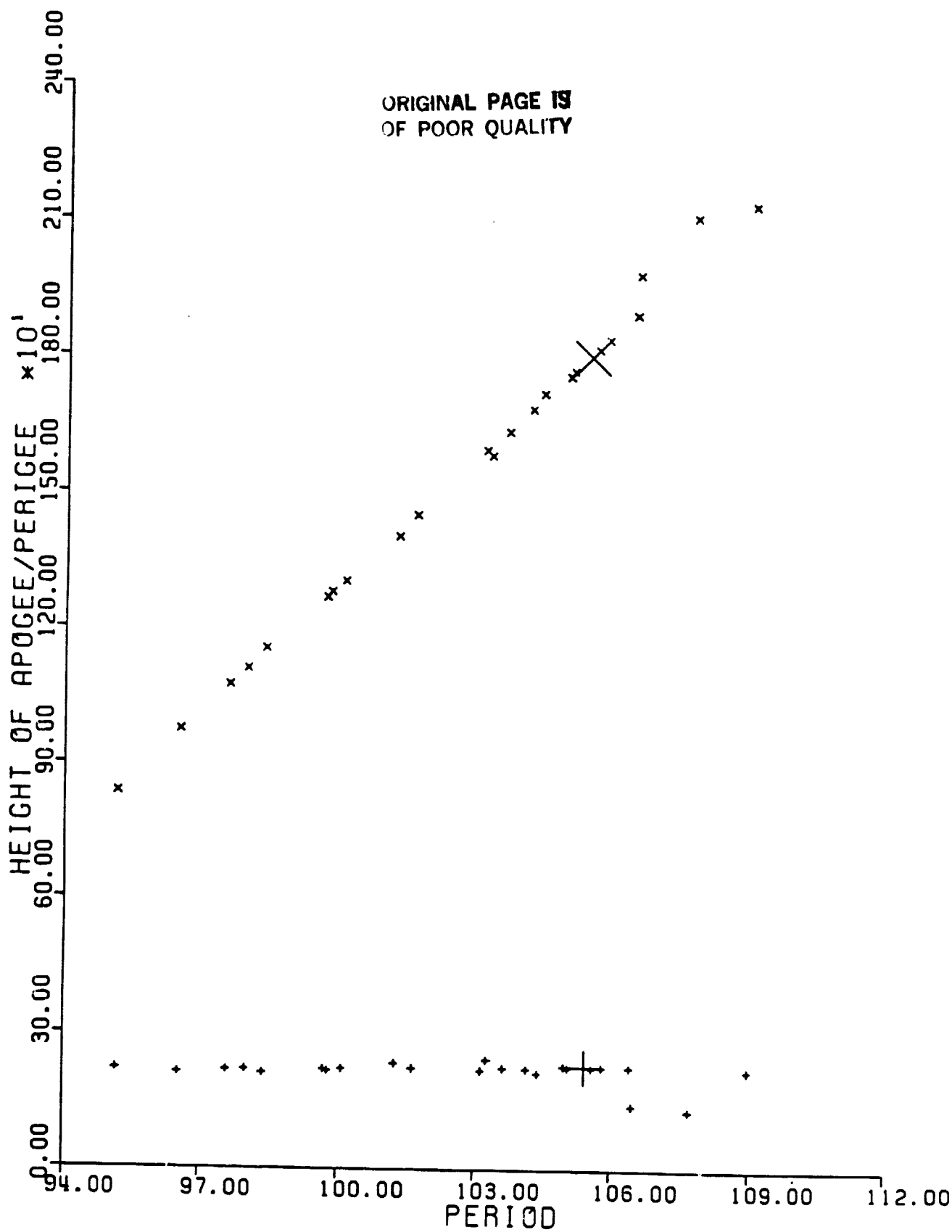
TRUE ANOMALY: 359°

COMMENTS:

- Alleged Soviet ASAT test.
- General shape was cylinder?; length 4 m?; dia. 2 m?
- Orbit data derived from element set #1 for satellite 5646.
- Break-up occurred at perigee in vicinity of the alleged target satellite (Kosmos 459).

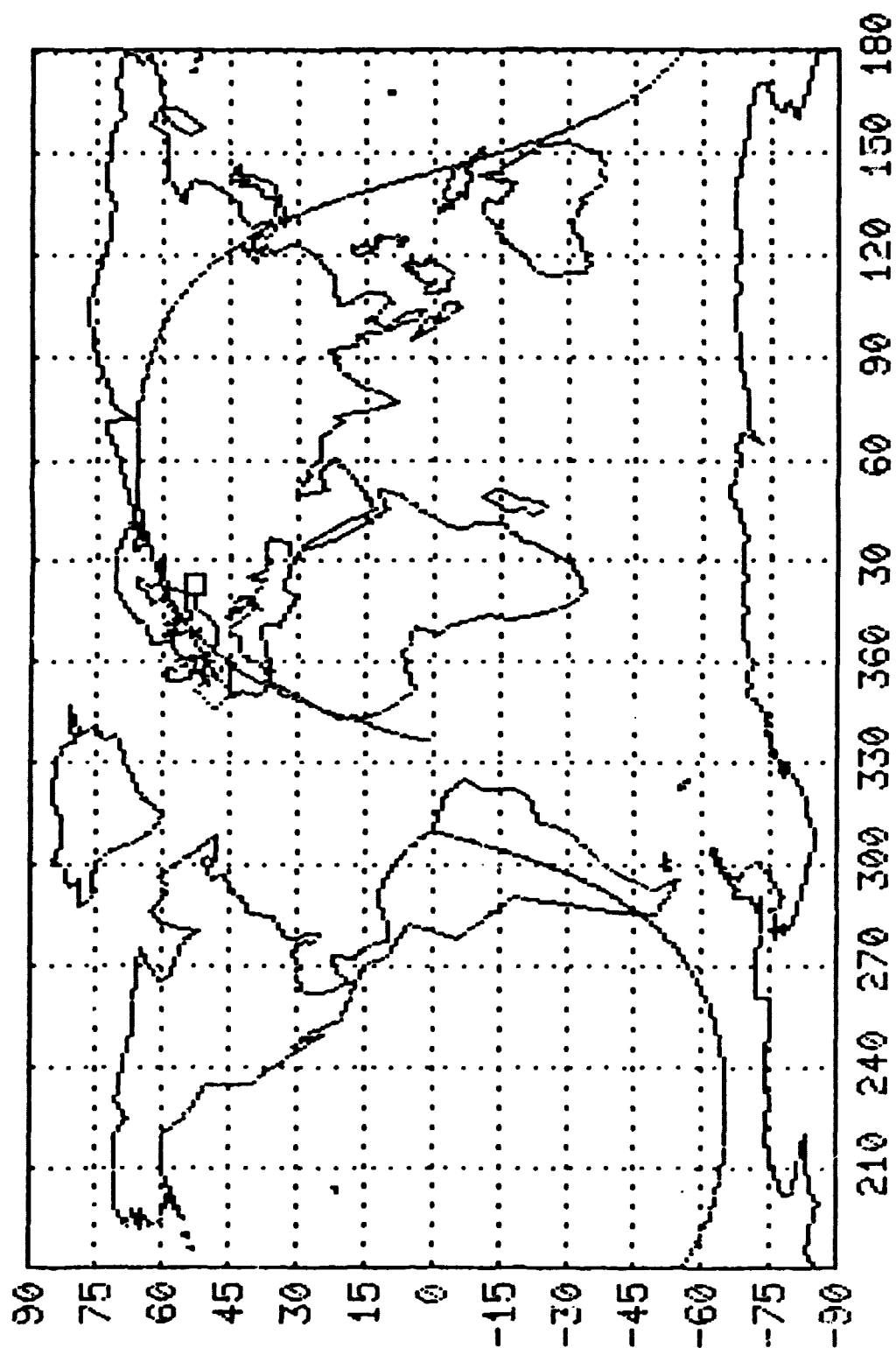
CAUSE: Planned fragmentation as part of an alleged USSR ASAT test.

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COSMOS 462

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COSMOS 462

1972-58

LANDSAT 1 R/B

6127

LAUNCH DATE: 23.75 Jul 1972

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 22 May 1975 (DAY 142)

TIME: 182720.5 GMT

LOCATION: 34 S/46 E

ALTITUDE: 725 km

PIECES CATALOGED (1 JAN 84): 218

PIECES STILL IN ORBIT (1 JAN 84): 88

ORBIT CHARACTERISTICS:

INCLINATION: 98.34°

APOGEE: 909 km

PERIGEE: 633 km

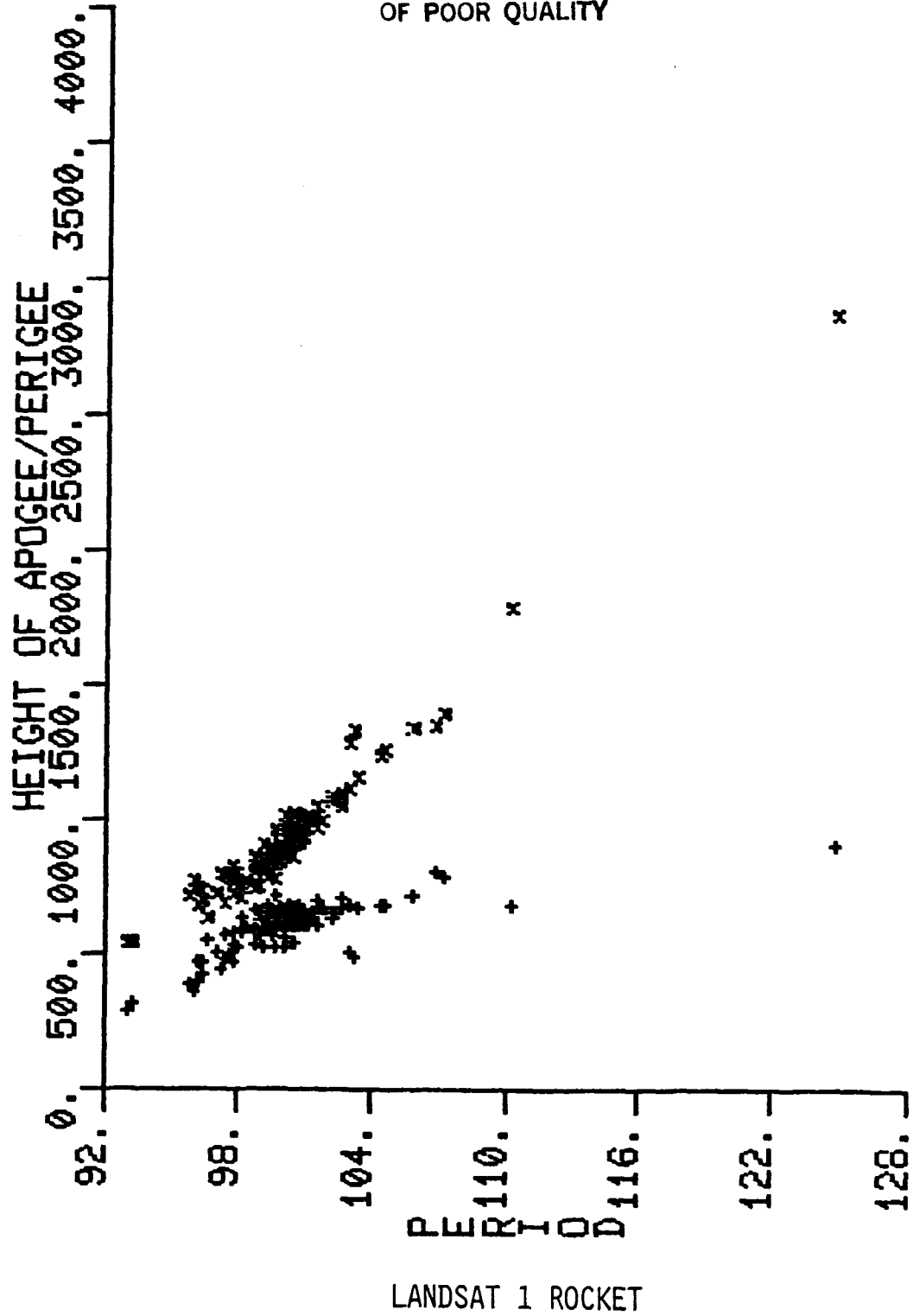
PERIOD: 100.3 min

TRUE ANOMALY: 289°

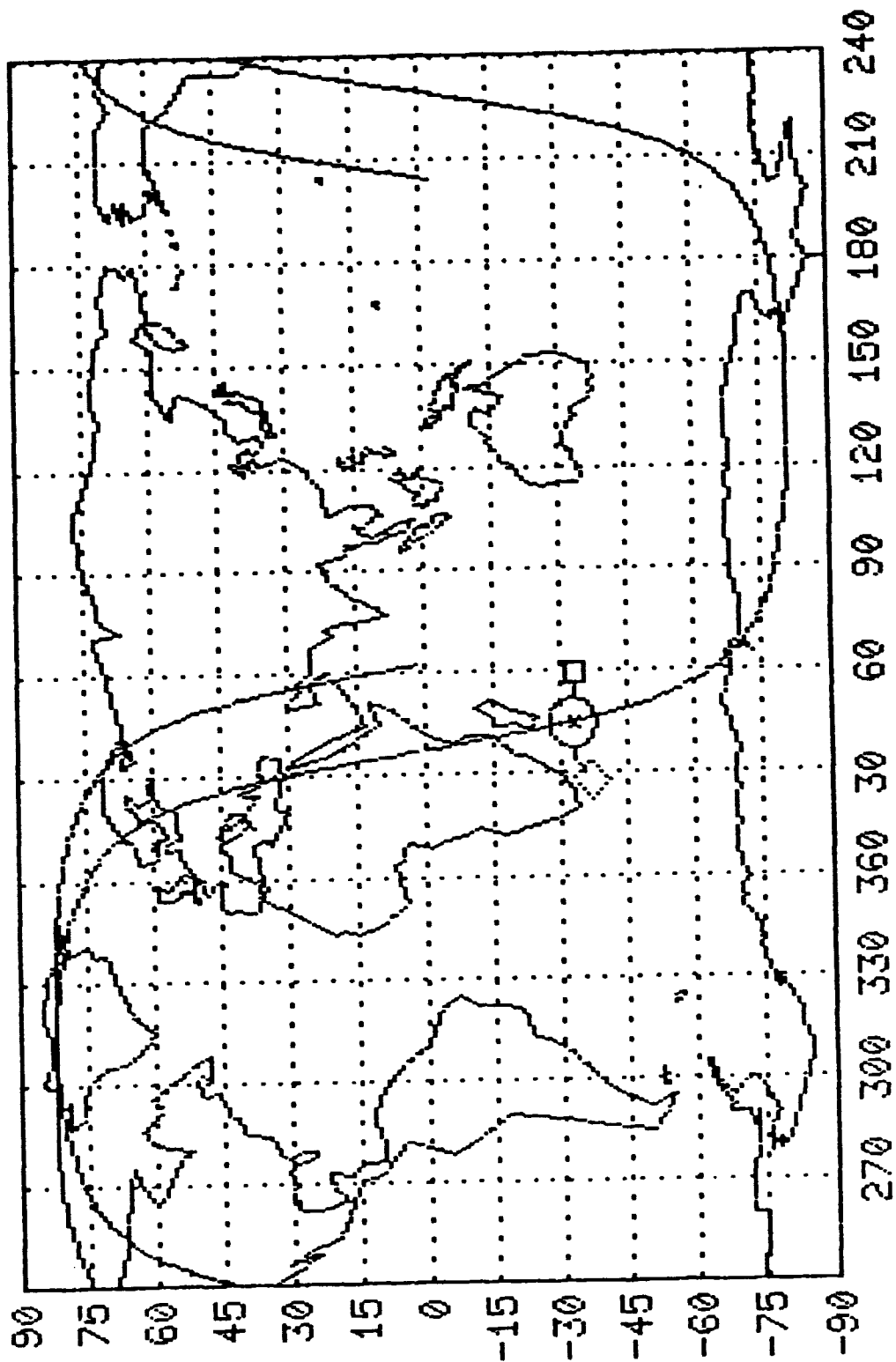
- COMMENTS:**
- Delta 2nd stage rocket.
 - General shape was cylinder; length 4.9 m; dia. 1.43 m; weight 350 kg?
 - Orbit data derived from element set #260 on satellite 6127.

CAUSE: Hypergolic fuel ignition due to tank bulkhead rupture is the most probable cause.

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LANDSAT 1 R/B

1973-17

SALYUT 2 R/B

6399

LAUNCH DATE: 3.38 Apr 1973

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 3 Apr 1973 (DAY 93)

TIME: 223626.9 GMT

LOCATION: 45 N/290 E

ALTITUDE: 224 km

PIECES CATALOGED (1 JAN 84): 25

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 51.48°

APOGEE: 244 km

PERIGEE: 195 km

PERIOD: 88.9 min

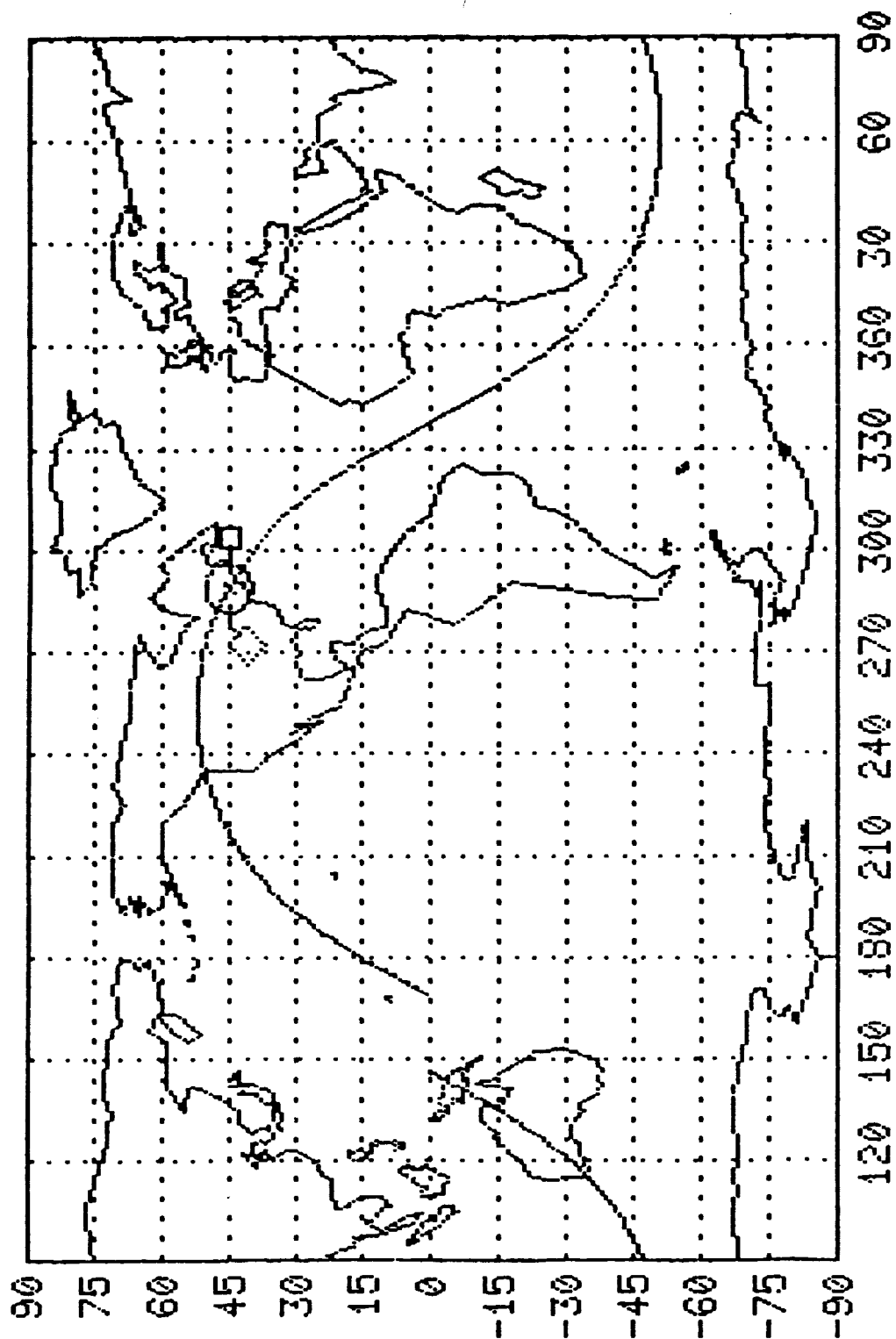
TRUE ANOMALY: 112°

- COMMENTS:**
- General shape was cylinder; length 12 M?; dia. 4 m.?; weight 400 kg?
 - Orbit data derived from element set #1 for satellite 6399.

CAUSE: Unknown

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SALYUT 2 R/B

1973-21

COSMOS 554

6432

LAUNCH DATE: 19.38 Apr 1973

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 6 May 1973 (DAY 126)

TIME: 072333.0 GMT

LOCATION: 71 S/215 E

ALTITUDE: 309 km

PIECES CATALOGED (1 JAN 84): 196

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 72.85

APOGEE: 350 km

PERIGEE: 168 km

PERIOD: 89.7 min

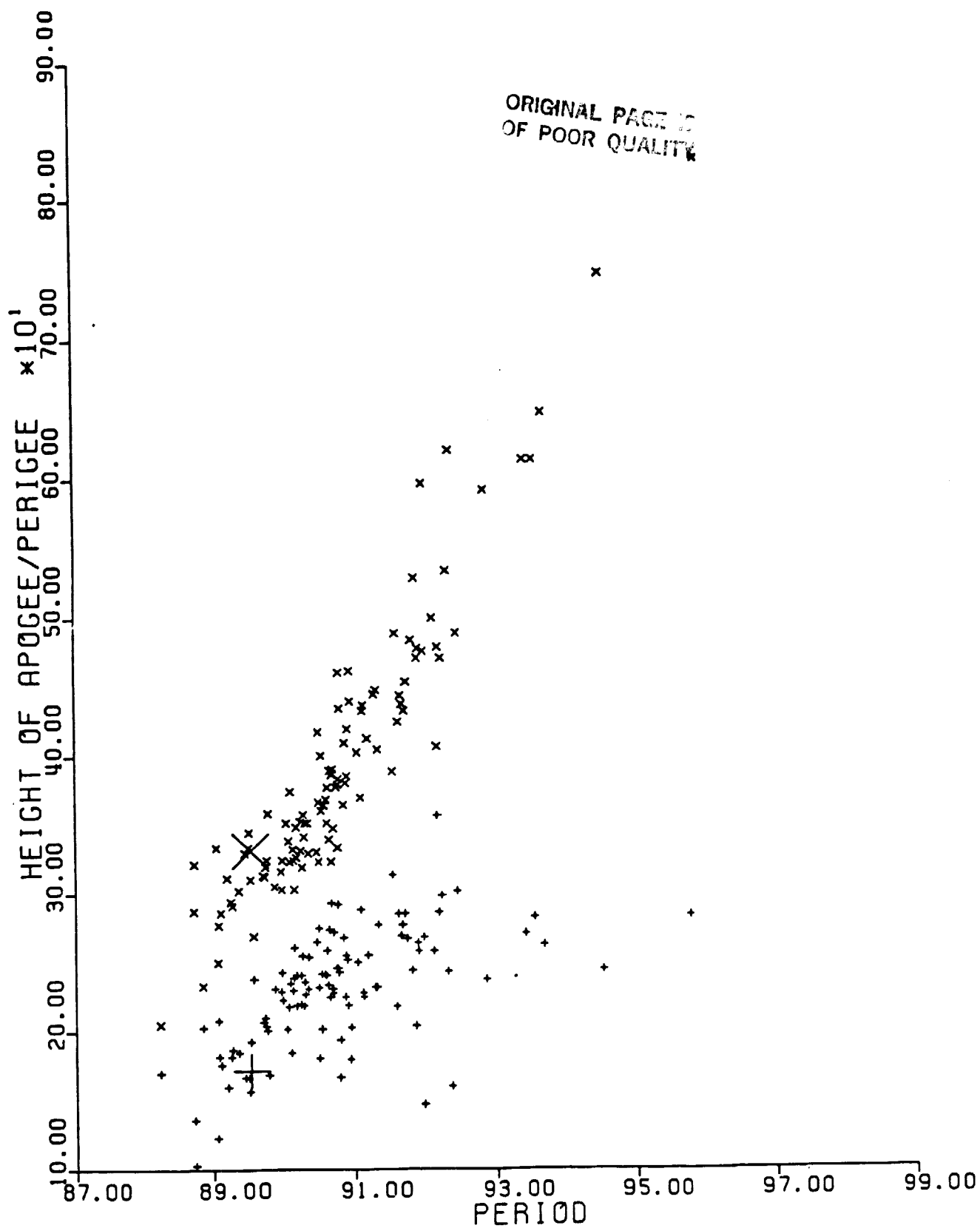
TRUE ANOMALY: 251°

- COMMENTS:**
- General shape was sphere-cylinder; length 5 m?; dia. 2 m?; weight 4000 kg?
 - 88 debris cataloged with "no initial elements." This count is contained in "pieces cataloged" count.

CAUSE: Intentionally destroyed by USSR

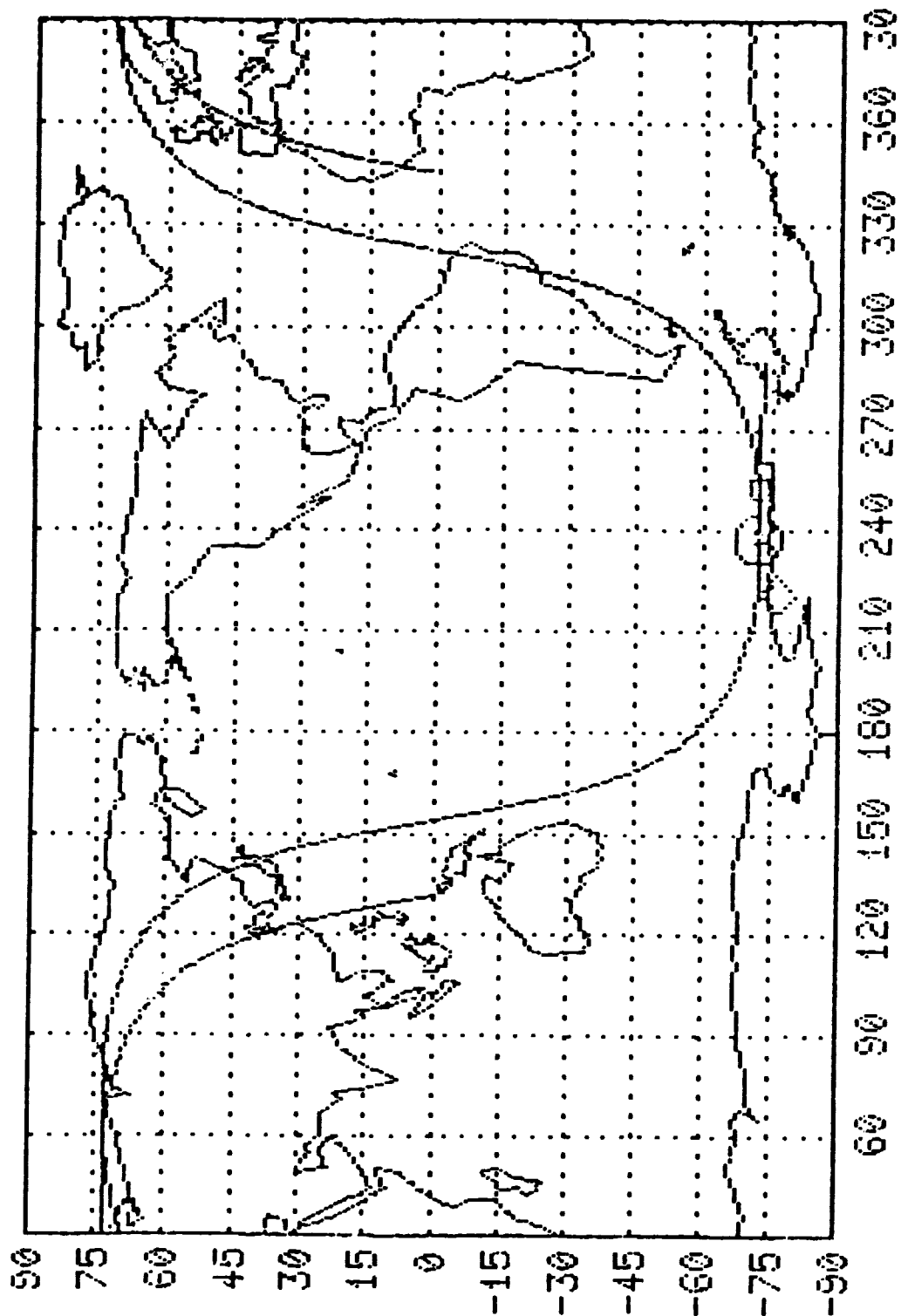
1973-21

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COSMOS 554

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COSMOS 554

1973-86

NOAA-3 ROCKET

6921

LAUNCH DATE: 6.71 Nov 1973

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 28 Dec 1973 (DAY 362)

TIME: 090800.0 GMT

LOCATION: 26 S/176 E

ALTITUDE: 1513 km

PIECES CATALOGED (1 JAN 84): 180

PIECES STILL IN ORBIT (1 JAN 84): 168

ORBIT CHARACTERISTICS:

INCLINATION: 102.05°

APOGEE: 1513 km

PERIGEE: 1504 km

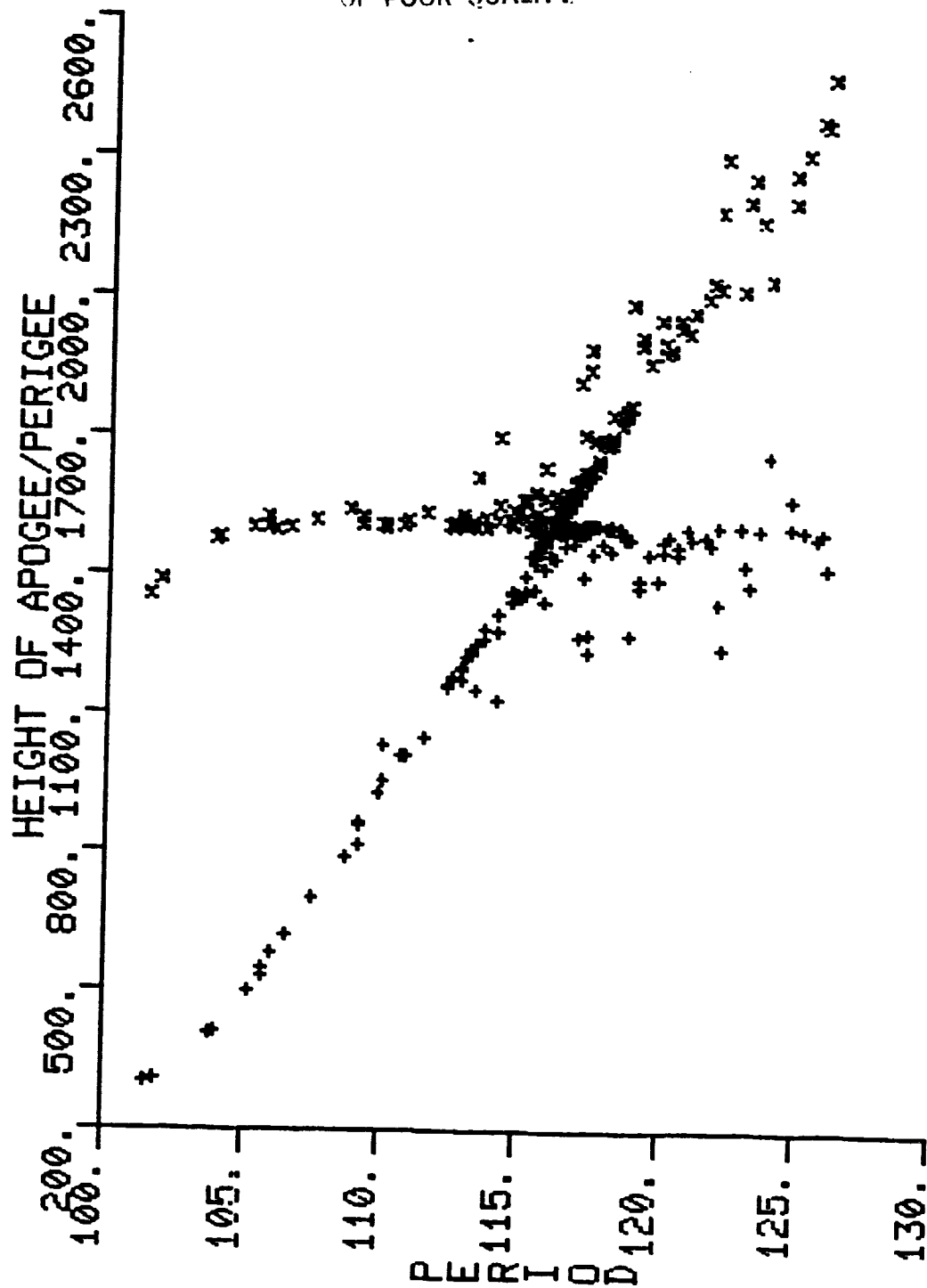
PERIOD: 116.2 min

TRUE ANOMALY: 181°

- COMMENTS:**
- Delta 2nd stage rocket
 - General shape was cylinder; length 4.9 m; dia. 1.43 m; weight 350?
 - Orbit data derived from element set #15 for satellite 6921.
 - Time and location of this event taken from analysis of NOAA-3 (ITOS-F) rocket body breakup by R. R. Dasenbrock, B. Kaufman and W. B. Heard and reported in AAS/AIAA paper No. AAS-75-040.

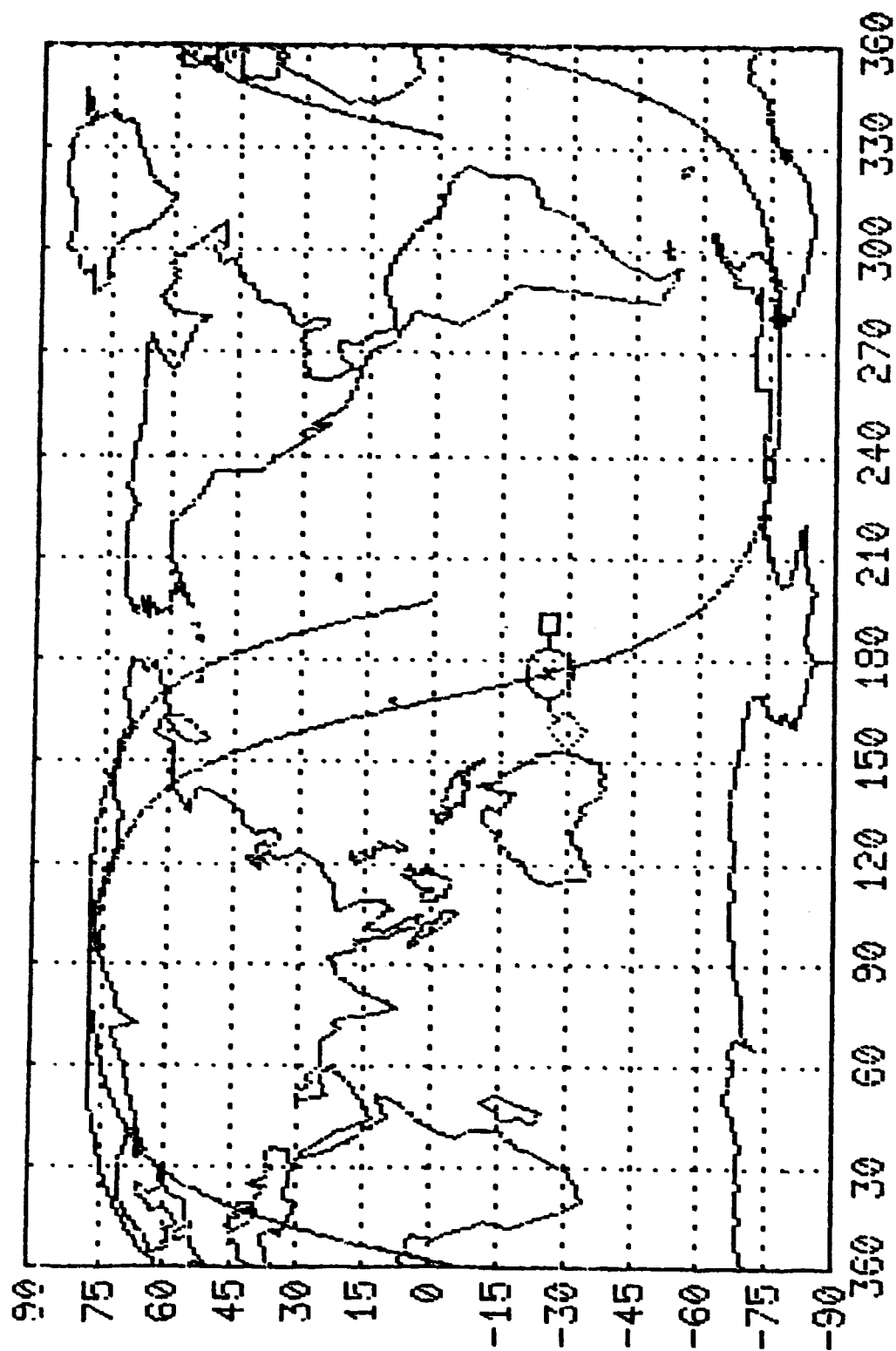
CAUSE: Hypergolic fuel ignition due to ruptured fuel tank bulkhead most probable cause.

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NOAA-3 ROCKET

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NOAA-3 R/B

1974-74

COSMOS 686 ROCKET

7448

LAUNCH DATE: 26.69 Sept 1974

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 26 Sept 1974 (DAY 269)

TIME: 213538.2 GMT

LOCATION: 26 N/94 E

ALTITUDE: 355 km

PIECES CATALOGED (1JAN 84): 19

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 70.9°

APOGEE: 456 km

PERIGEE: 259 km

PERIOD: 91.7 min

TRUE ANOMALY:

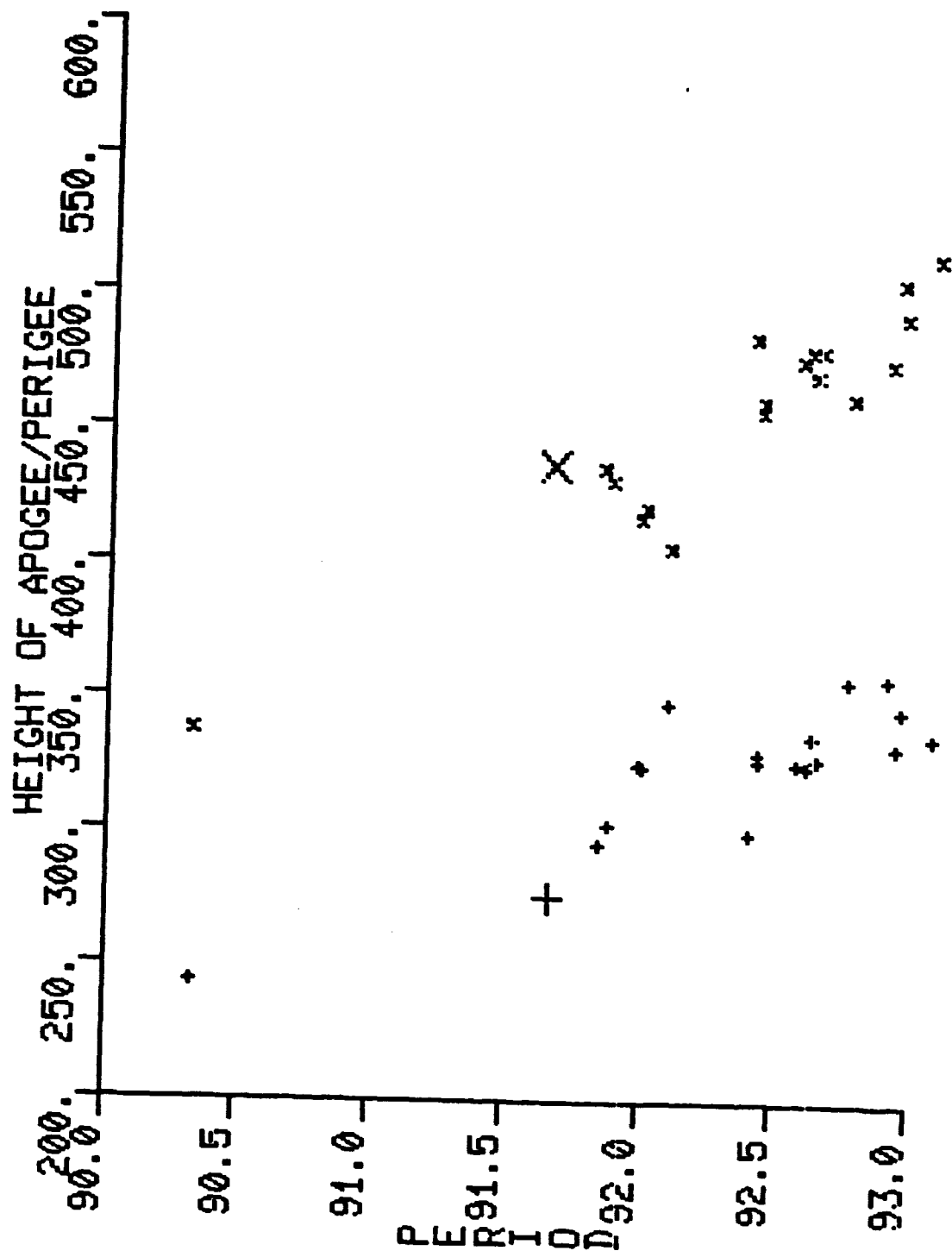
COMMENTS:

- Orbit data derived from element set #1 for satellite 7448
- General shape was cylinder; length 8 m; dia. 1.65 m; weight 1500 kg?
- All fragments were launched forward except one. This fragment was cataloged after it had decayed.

CAUSE: Unknown

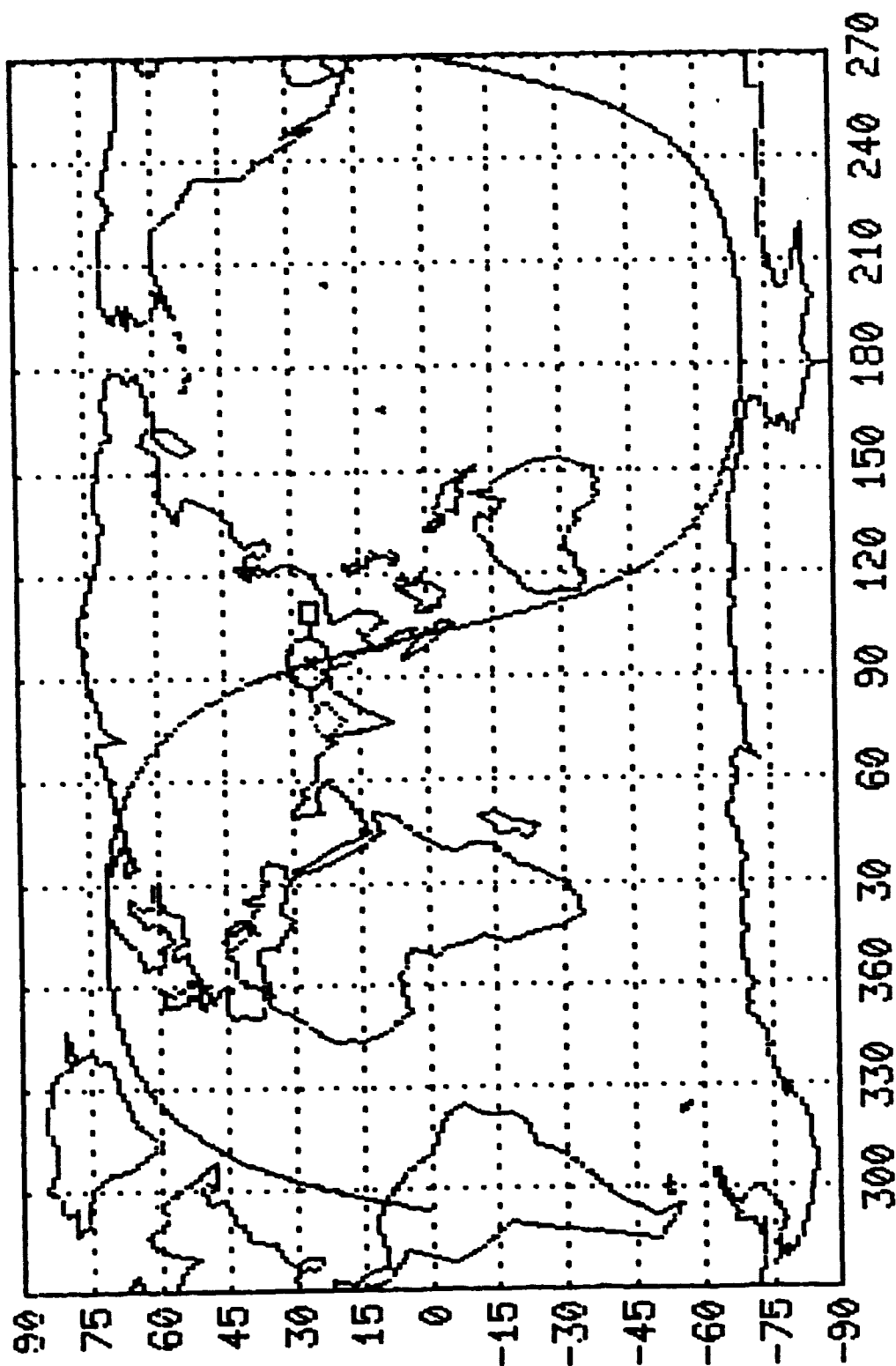
1974-74

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COSMOS 686

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COSMOS 686

1974-89

NOAA-4 R/B

7532

LAUNCH DATE: 15.72 Nov 1974

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 20 Aug 1975 (DAY 232)

TIME: 130638.8 GMT

LOCATION: 52 S/278 E

ALTITUDE: 1460 km

PIECES CATALOGED (1 JAN 84): 132

PIECES STILL IN ORBIT (1 JAN 84): 124

ORBIT CHARACTERISTICS:

INCLINATION: 101.69°

APOGEE: 1460 km

PERIGEE: 1445 km

PERIOD: 114.9 min

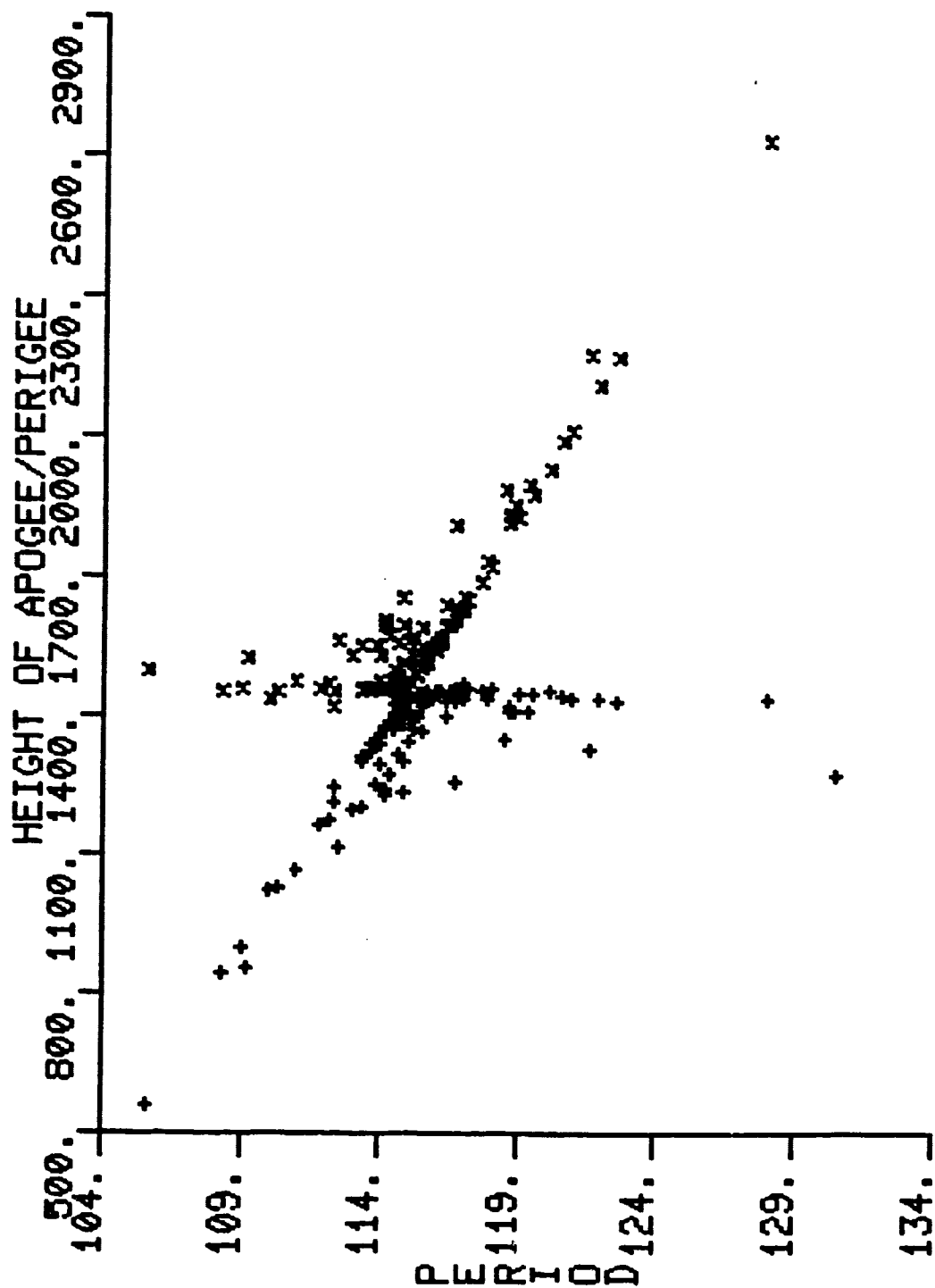
TRUE ANOMALY: 185°

COMMENTS:

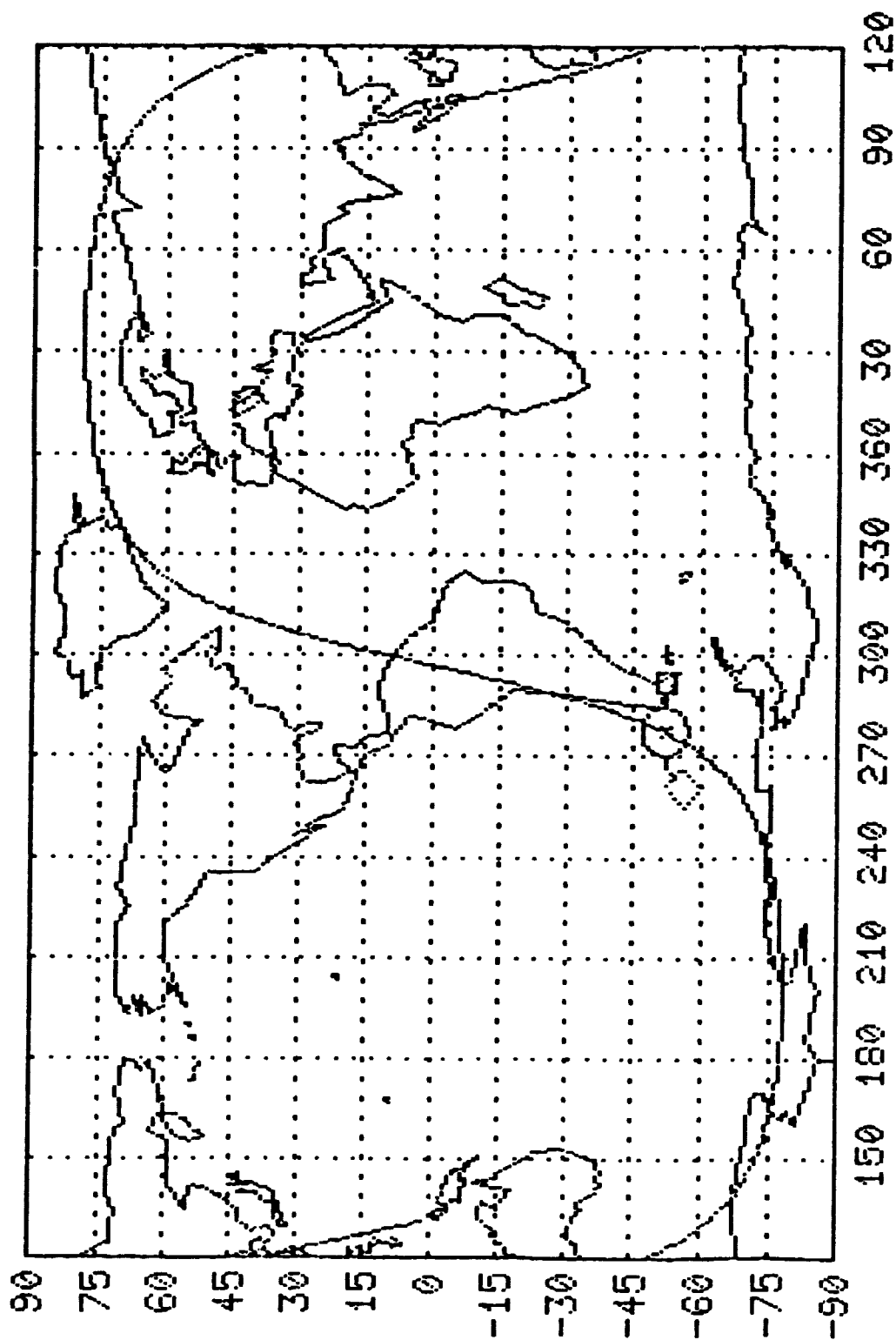
- Delta 2nd stage rocket.
- General shape was cylinder; length 4.9 m; dia. 1.43 m; weight 350 kg?
- Orbit data derived from element set #64 on satellite 7532.

CAUSE: Hypergolic fuel ignition due to ruptured fuel tank bulkhead most probable cause.

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NOAA-4 ROCKET



NOAA-4 R/B

1974-103

COSMOS 699

7587

LAUNCH DATE: 24.46 Dec 1974

COUNTRY OF ORIGIN: USSR

EVENT DATA:

1.

2.

DATE: 17 Apr 1975 (DAY 107)

2 Aug 1975 (DAY 214)

TIME: 214825.5

162310.0

LOCATION: 01 N/278 E

2 S/258 E

ALTITUDE: 437 km

433 km

PIECES CATALOGED (1 JAN 84): 50

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 65.04°

65.05°

APOGEE: 444 km

442 km

PERIGEE: 424 km

414 km

PERIOD: 93.3 min

93.1 min

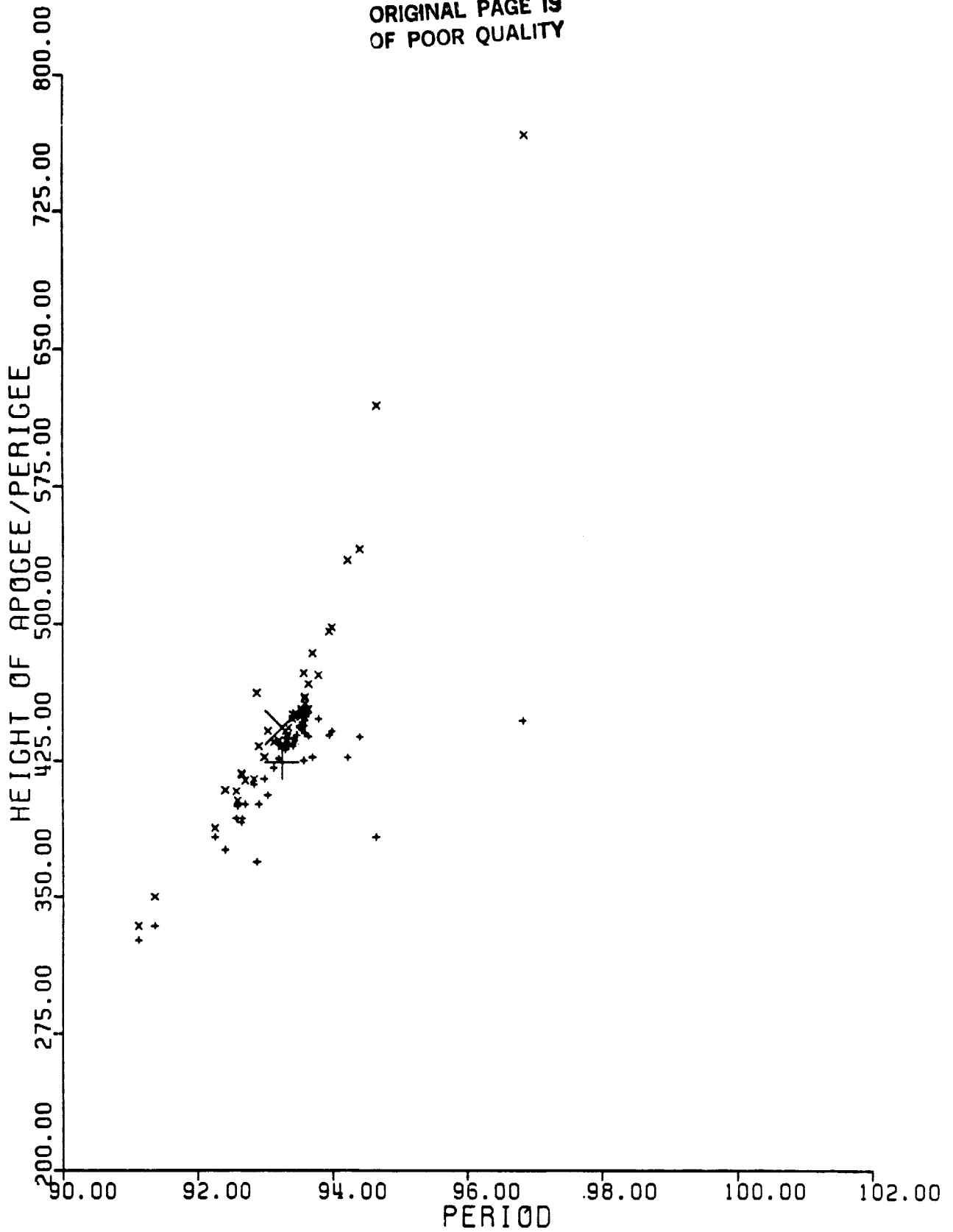
TRUE ANOMALY: 250°

250°

- Comments:
- Orbit data derived from element set #132 and #333 for satellite 7587; 1st and 2nd events respectively.
 - This event analyzed by William Heard of the Naval Research Laboratory. Report on file at Teledyne Brown Engineering, Colorado Springs, Colorado.
 - Debris highly unidirectional.
 - This was the first of a class of USSR satellites at 65° inclination and approximately 440 km altitude. The majority of the satellites in this class fragment.

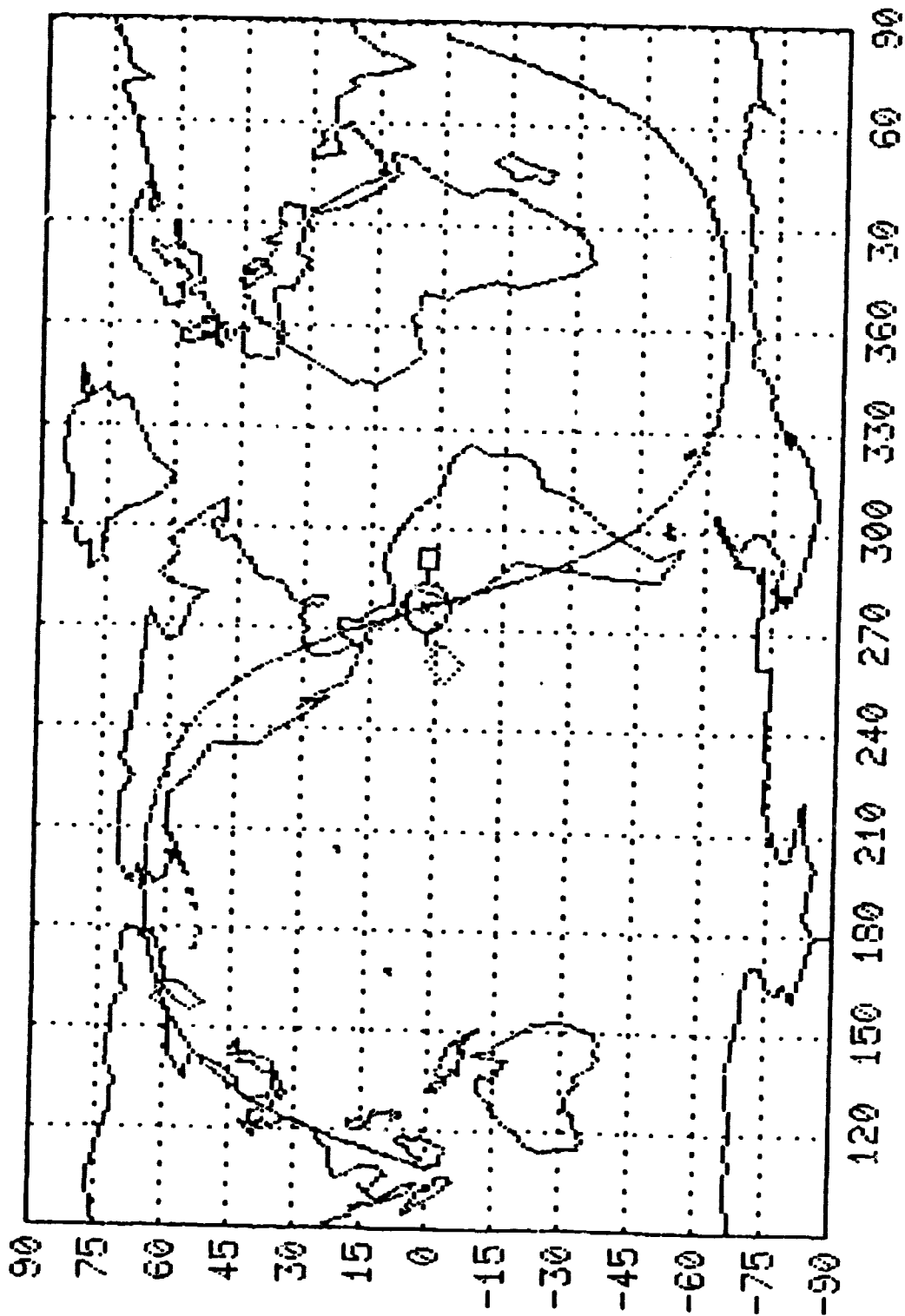
CAUSE: Apparently deliberate fragmentation.

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COSMOS 699
1st EVENT

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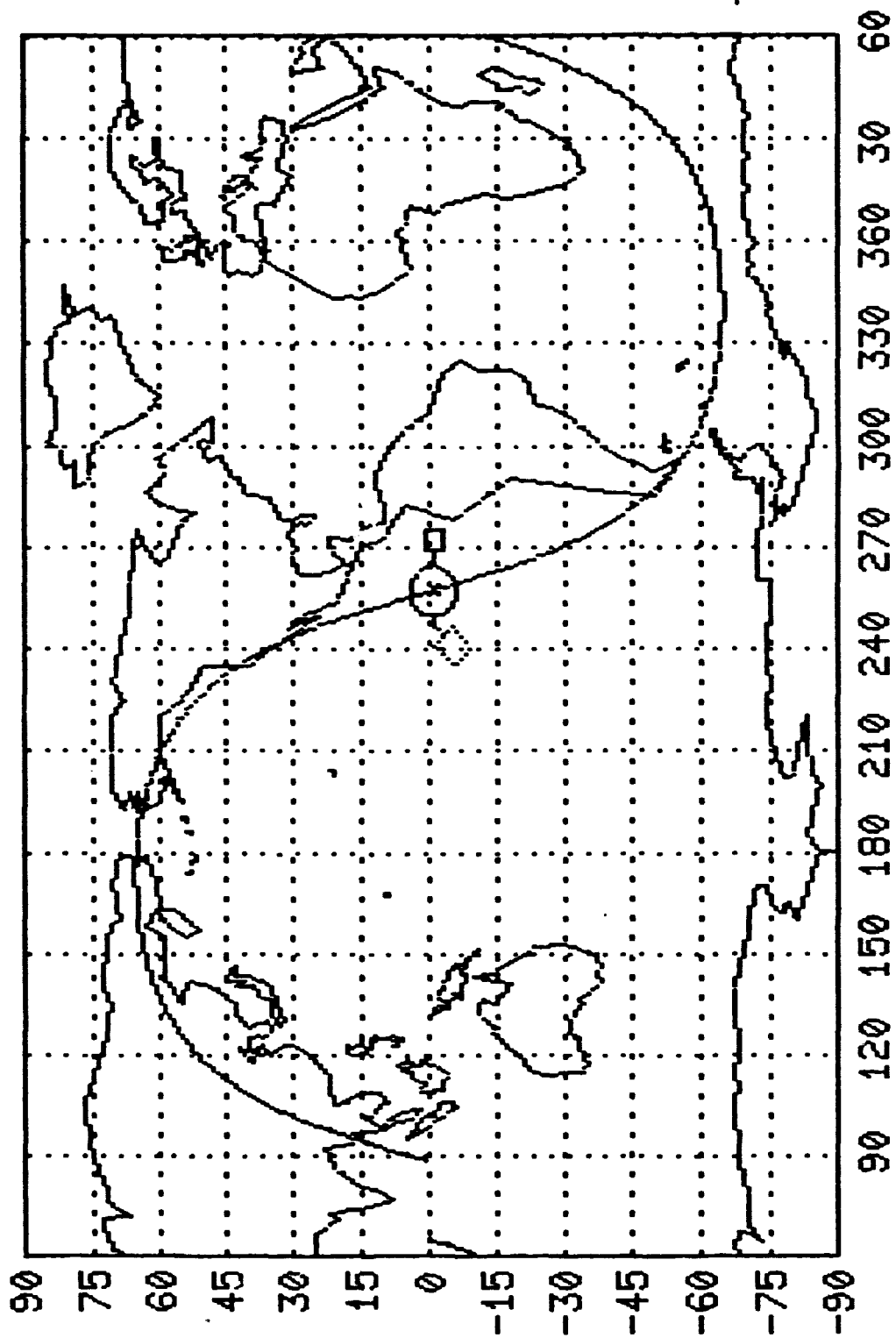


COSMOS 699 (EVENT 1)

COMMENTS: • Unable to unambiguously identify debris associated with 2nd event, therefore, an orbit distribution plot is not provided.

1974-103

ORIGINAL POSITION
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COSMOS 699 (EVENT 2)

1975-04

LANDSAT 2 ROCKET

7616

LAUNCH DATE: 22.75 Jan 1975

COUNTRY OF ORIGIN: US

EVENT DATA:

1.

2.

DATE: 9 Feb 1976 (DAY 40)

19 Jun 1976 (DAY 171)

TIME:

065916.6 GMT

LOCATION:

7 N/344 E

ALTITUDE:

751 km

PIECES CATALOGED (1 JAN 84): 14

183

PIECES STILL IN ORBIT (1 JAN 84): 54 (Both Events)

ORBIT CHARACTERISTICS:

INCLINATION: 97.78°

97.78°

APOGEE: 915 km

912 km

PERIGEE: 741 km

742 km

PERIOD: 101.5 min

101.4 min

TRUE ANOMALY:

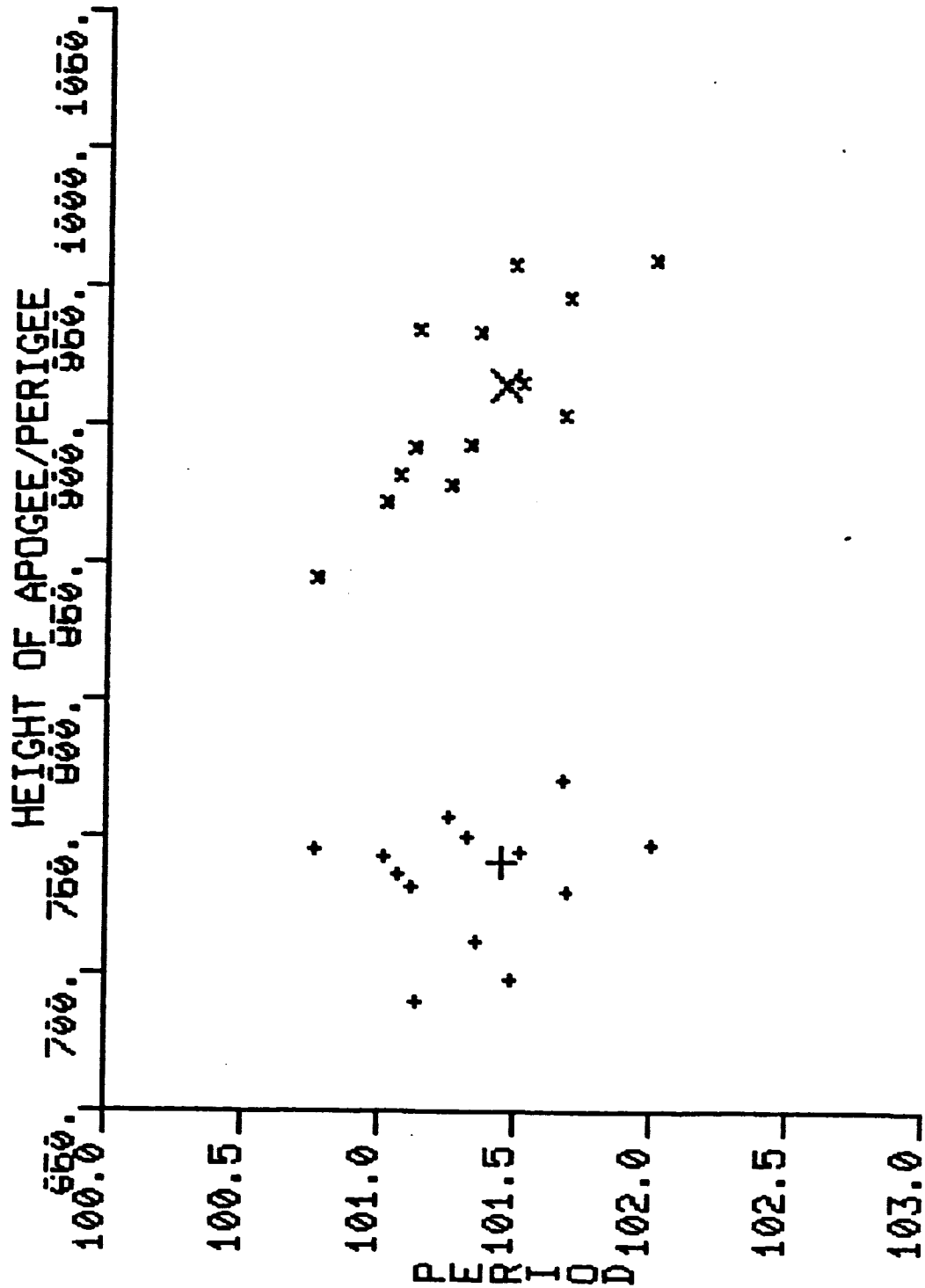
28°

COMMENTS:

- Delta 2nd stage rocket.
- Orbit data derived from element set #127 for satellite 7616, for 1st event; #145 for 2nd event.
- Two events. First event on 9 Feb 1976 was a small fragmentation resulting in only 14 pieces cataloged. The 2nd event followed the first by 131 days and was a far more forceful event.
- General shape was cylinder-annulus; length 6.4 m and 1.52 m; dia. 2.44 m; weight 350 kg?

CAUSE: Hypergolic fuel ignition due to ruptured fuel tank bulkhead most probable cause for 2nd event. 1st event unknown cause.

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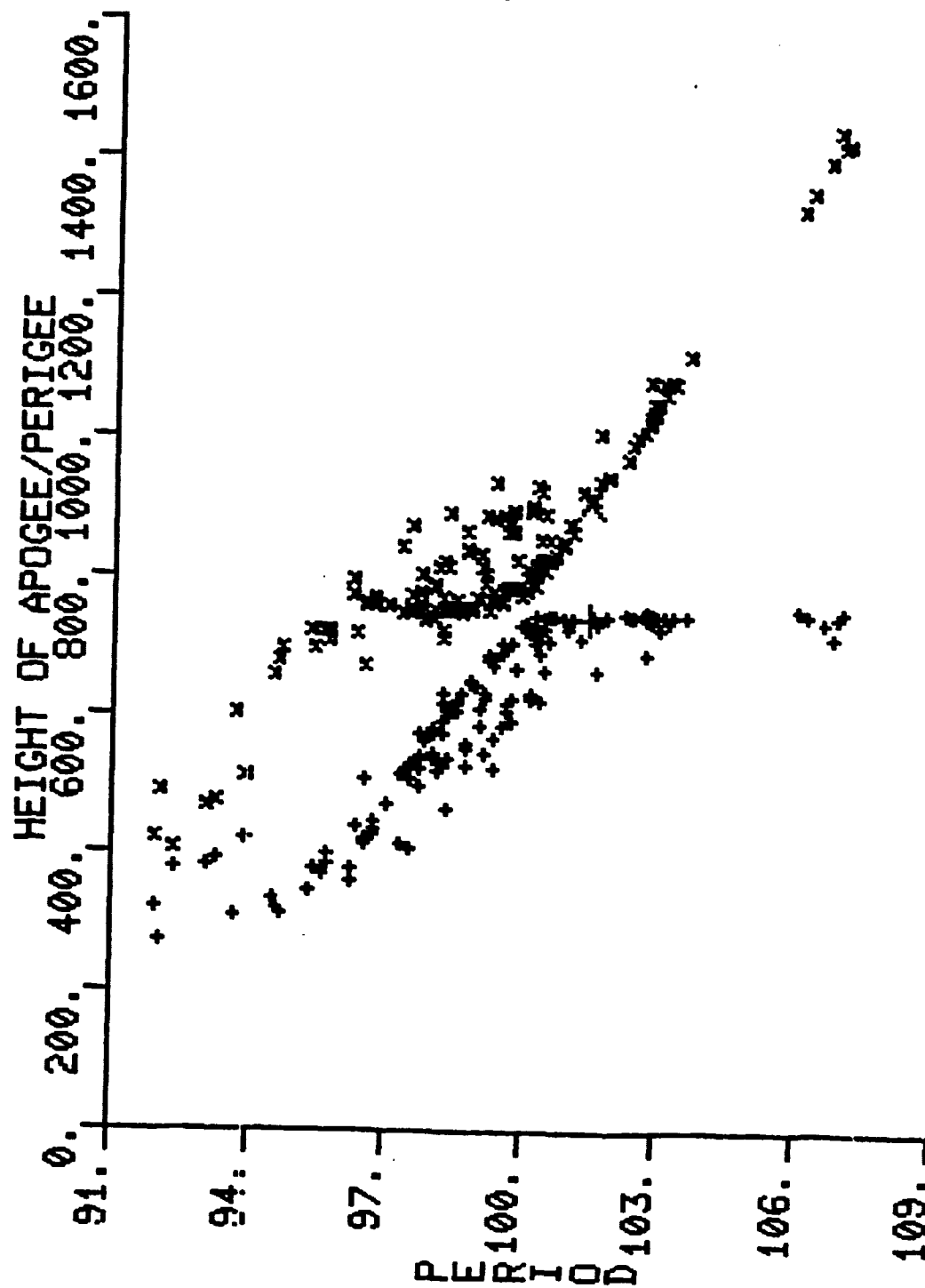
LANDSAT 2 ROCKET
1st EVENT

COMMENTS • Insufficient data to show applicable ground trace for satellite
7616, first event.

1975-04

1-147

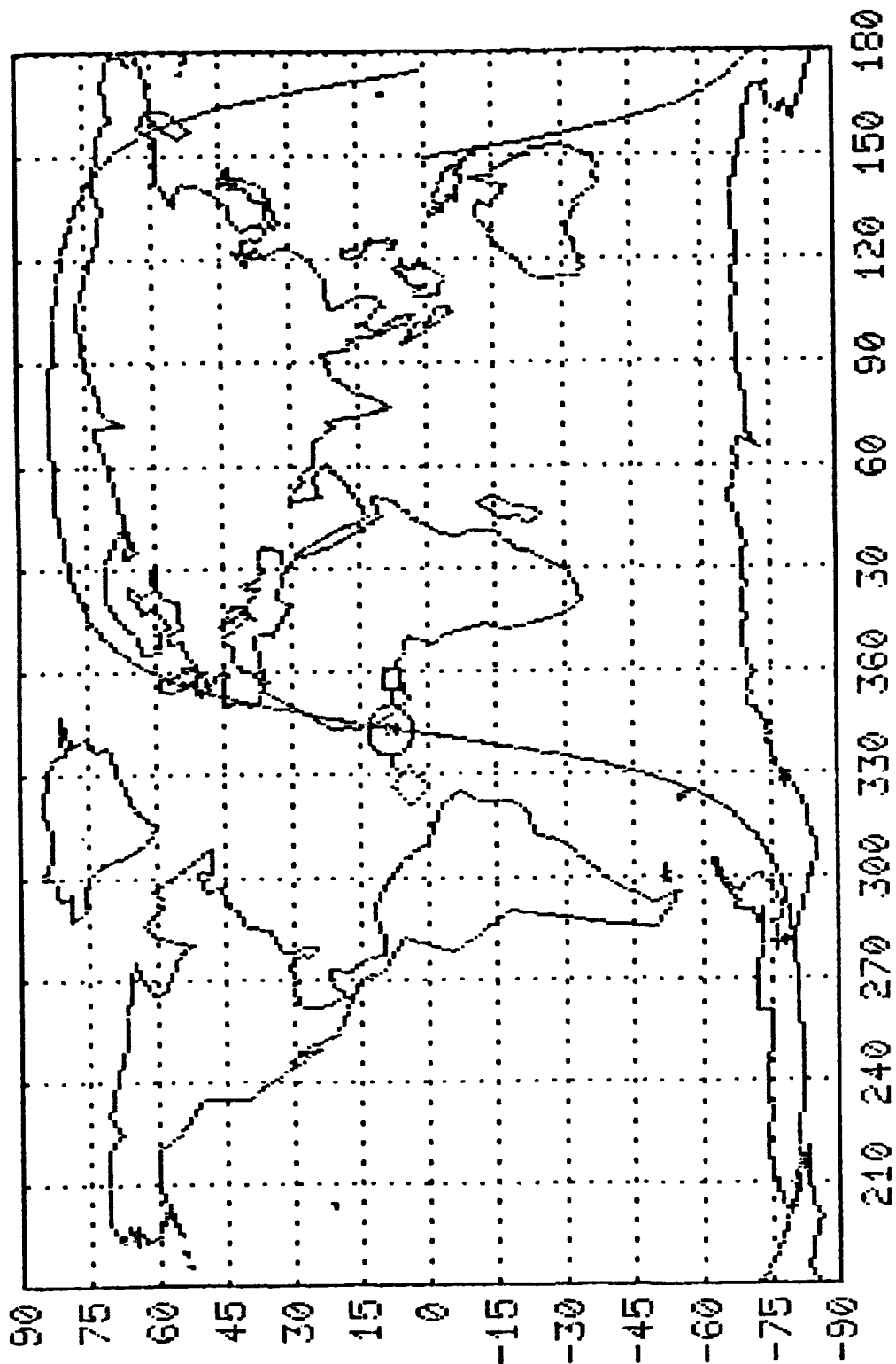
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LANDSAT 2 ROCKET

2ND EVENT

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LANDSAT 2 ROCKET

(EVENT 2)

1975-027

GEOS 3 ROCKET

7735

LAUNCH DATE: 10.00 Apr 1975

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 12 Mar 1978 (DAY 71)

TIME: ~ 1200 GMT

LOCATION:

ALTITUDE: ~ 840 km

PIECES CATALOGED (1 JAN 84): 5

PIECES STILL IN ORBIT (1 JAN 84): 3

ORBIT CHARACTERISTICS:

INCLINATION: 114.99°

APOGEE: 844 km

PERIGEE: 837 km

PERIOD: 101.7 min

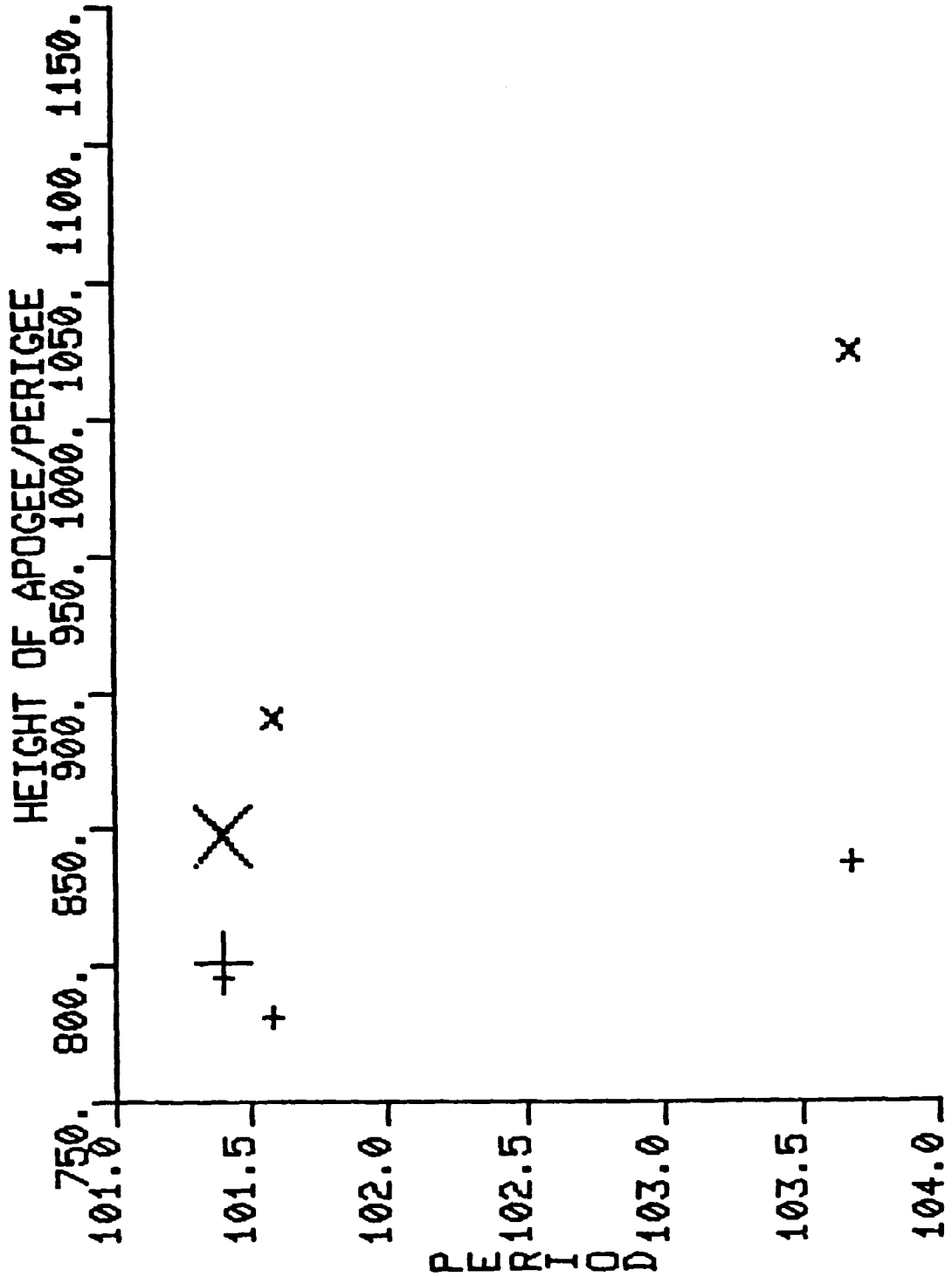
TRUE ANOMALY:

- COMMENTS:**
- Delta 2nd stage rocket.
 - No other event at this inclination.
 - This event was discovered when researching the NORAD satellite catalog for new objects cataloged with old launches.
 - Orbit data derived from 1 March 1978 element set on satellite 7735.
 - General shape was cylinder plus annulus; length 6.4 and 1.52 m; dia. 2.44 m; weight 350 kg?

CAUSE: Unknown; may not be related to the more violent mechanism which has plagued other Delta second stages.

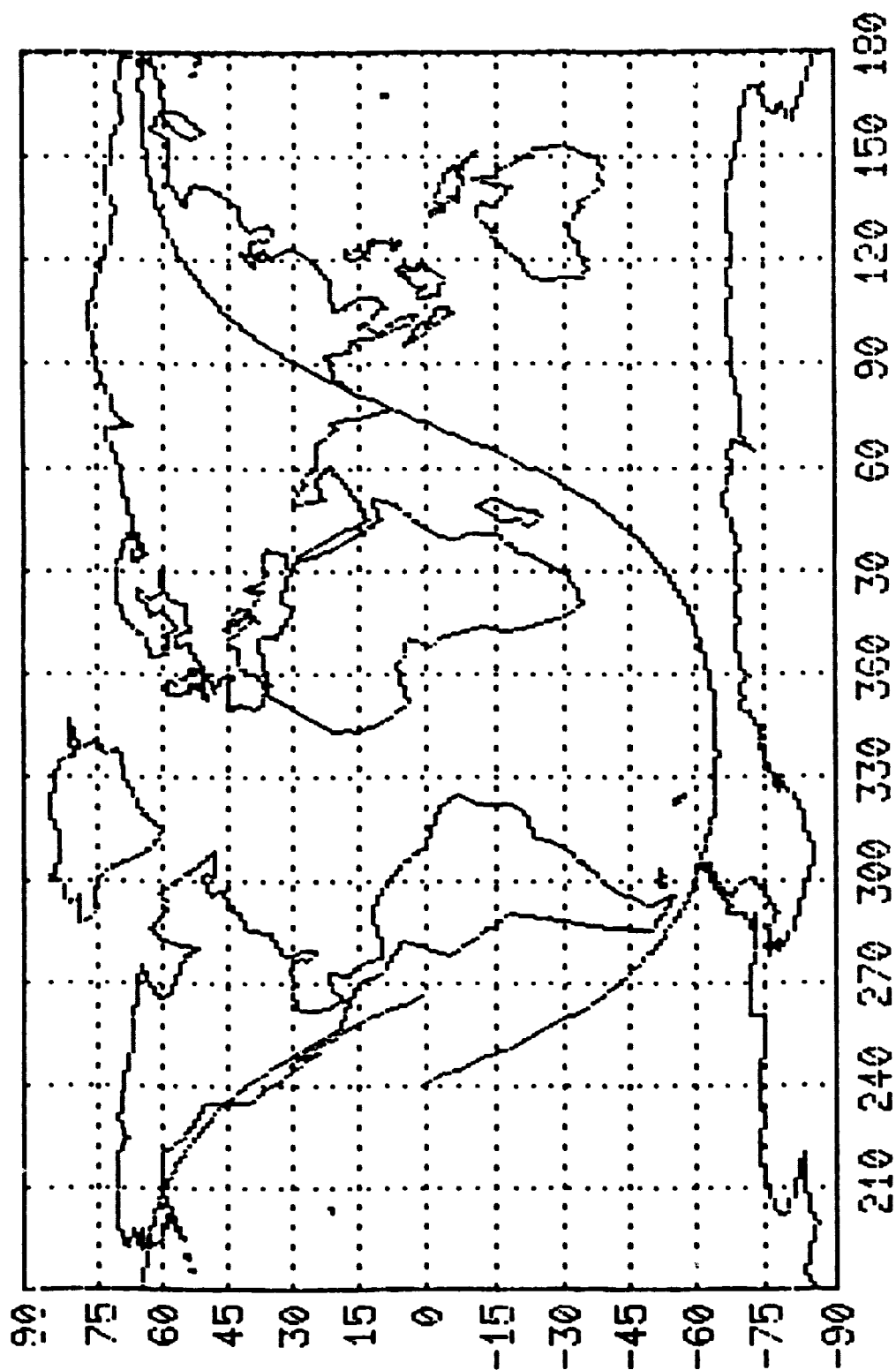
1975-27

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GEOS 3 ROCKET

ORIGINAL PAGE 19
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CEOS 3 ROCKET

1975-80

COSMOS 758

8191

LAUNCH DATE: 5.62 Sep 1975

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 6 Sep 1975 (DAY 249)

TIME: 190611.0 GMT

LOCATION: 32 N/293 E

ALTITUDE: 184 km

PIECES CATALOGED (1 JAN 84): 77

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 67.14

APOGEE: 324 km

PERIGEE: 173 km

PERIOD: 89.5 min

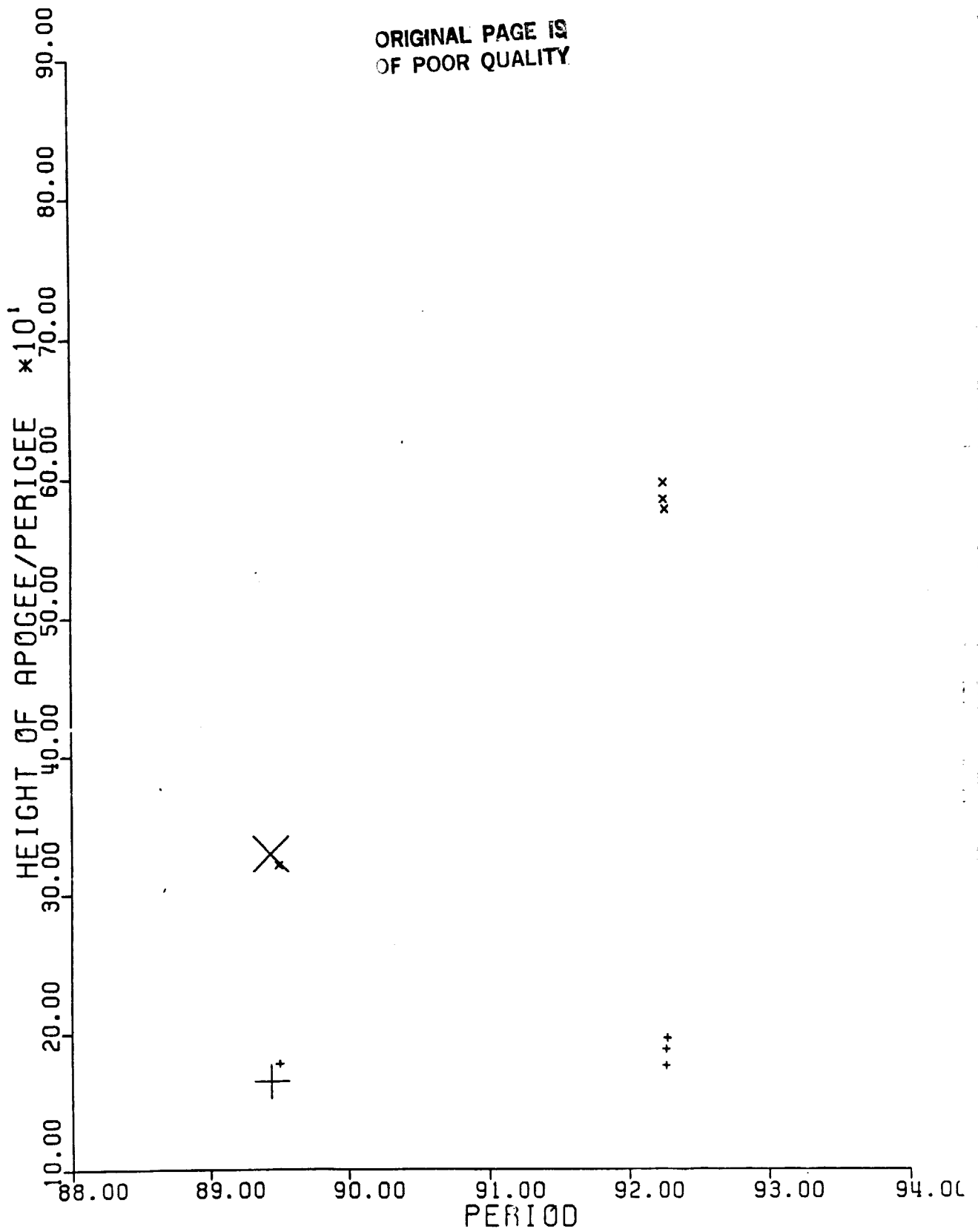
TRUE ANOMALY: 328°

- COMMENTS:**
- General shape was sphere-cylinder; length 7 m?; dia. 2.4 m; weight 6700 kg?
 - Orbit data derived from element set #5 for satellite 8191.
 - 72 pieces of those counted under "pieces cataloged" were cataloged without elements.

CAUSE: Possibly deliberately detonated.

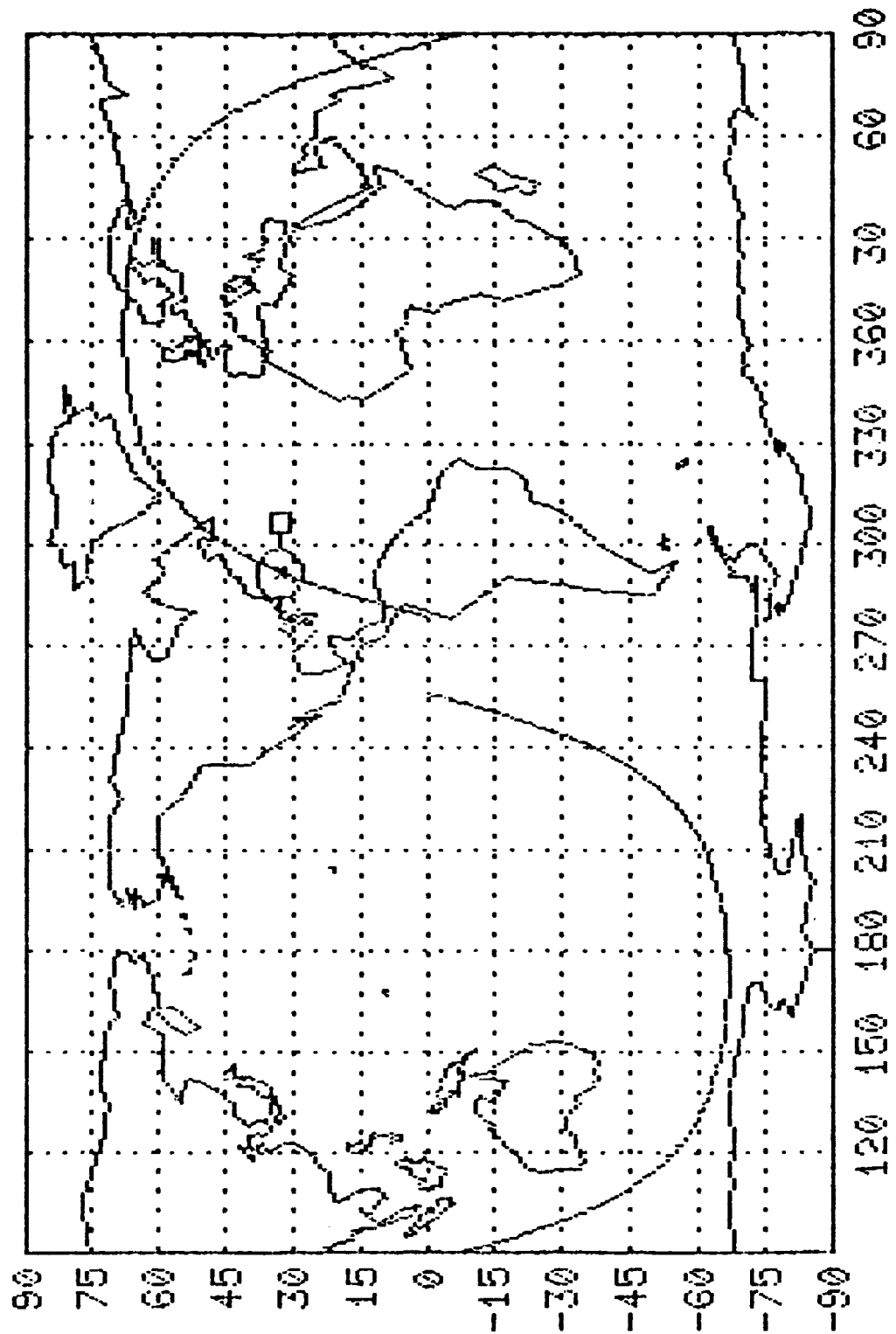
1975-80

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COSMOS 758

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COSMOS 758

1975-102

COSMOS 777

8416

LAUNCH DATE: 29.46 Oct 1975

COUNTRY OF ORIGIN: USSR

EVENT DATA: 1. 2.

DATE: 25 Jan 1976 (DAY 25) 25 Jan 1976 (DAY 25)

TIME: 135941.1 GMT 152928.0 GMT

LOCATION: 53 N/7 E 42 N/331 E

ALTITUDE: 441 km 440 km

PIECES CATALOGED (1 JAN 84): 62

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 65.02° 66.02°

APOGEE: 442 km 442 km

PERIGEE: 430 km 430 km

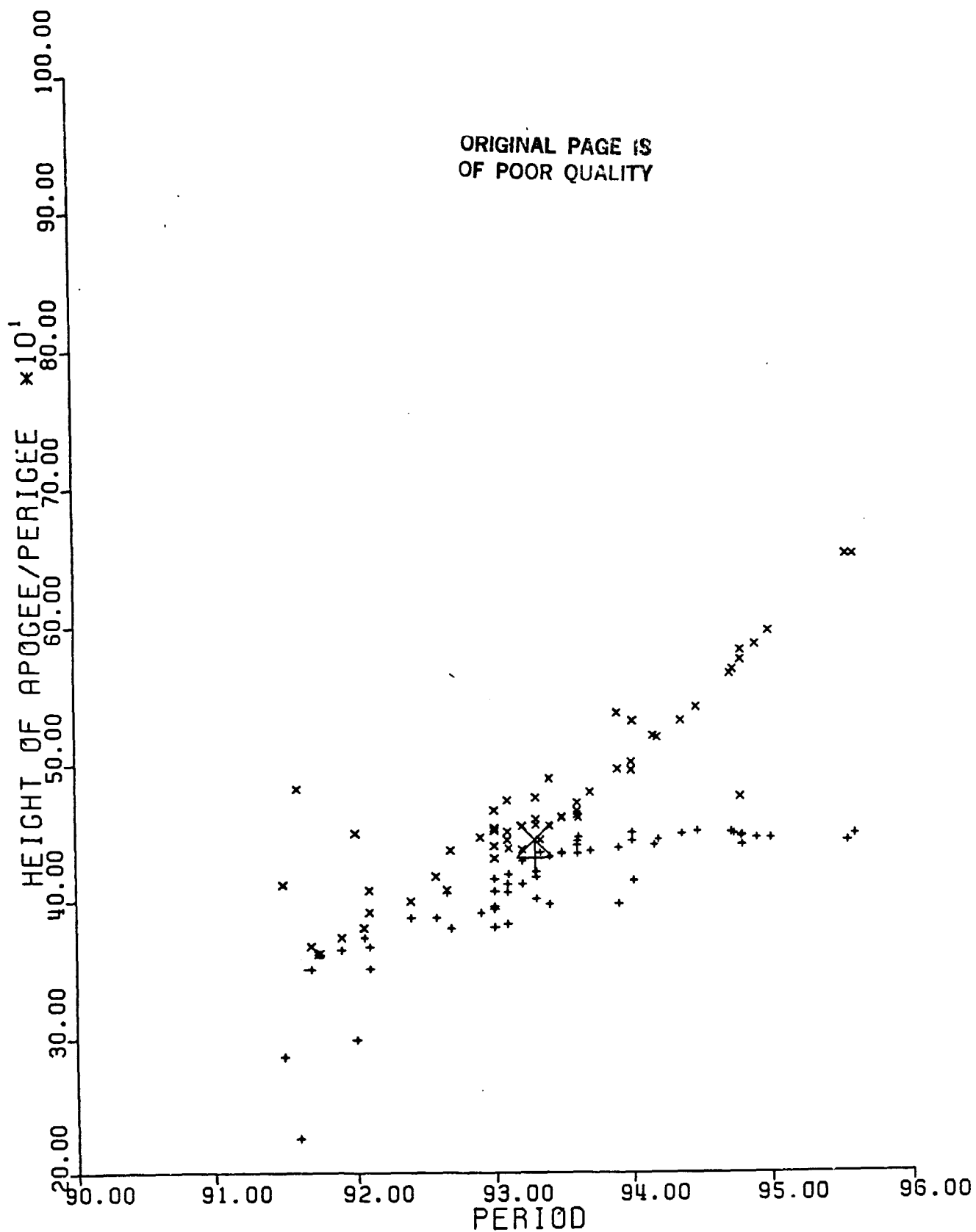
PERIOD: 93.3 min 93.3 min

TRUE ANOMALY: 151° 138°

- COMMENTS:**
- Payload still active when it fragmented.
 - Orbit data derived from element set #96 for satellite 8416.
 - 2 events about 1 orbital revolution apart in time.
 - Member of Cosmos 699 class.

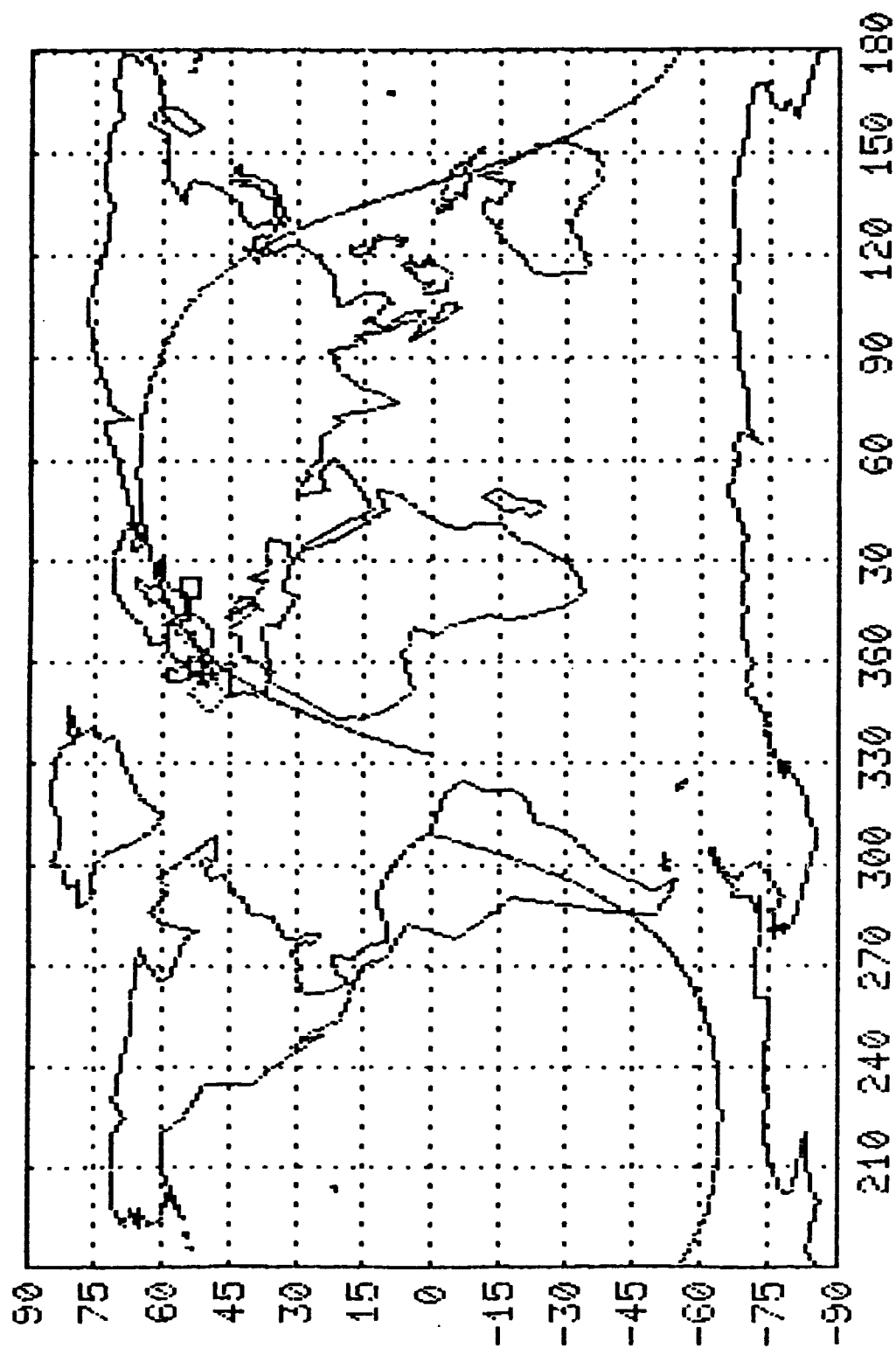
CAUSE: Apparently deliberate fragmentation.

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COSMOS 777

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COSMOS 777 #1

COMMENTS: • Unable to unambiguously identify debris associated with event 2, therefore, an orbit distribution plot is not provided for event 2.

1-163

1976-63

COSMOS 838

8932

LAUNCH DATE: 2.44 Jul 1976

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 17 May 1977 (DAY 137)

TIME: 101758.7 GMT

LOCATION: 9 S/284 E

ALTITUDE: 431 km

PIECES CATALOGED (1 JAN 84): 40

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 65.06°

APOGEE: 444 km

PERIGEE: 415 km

PERIOD: 93.2 min

TRUE ANOMALY: 263°

COMMENTS:

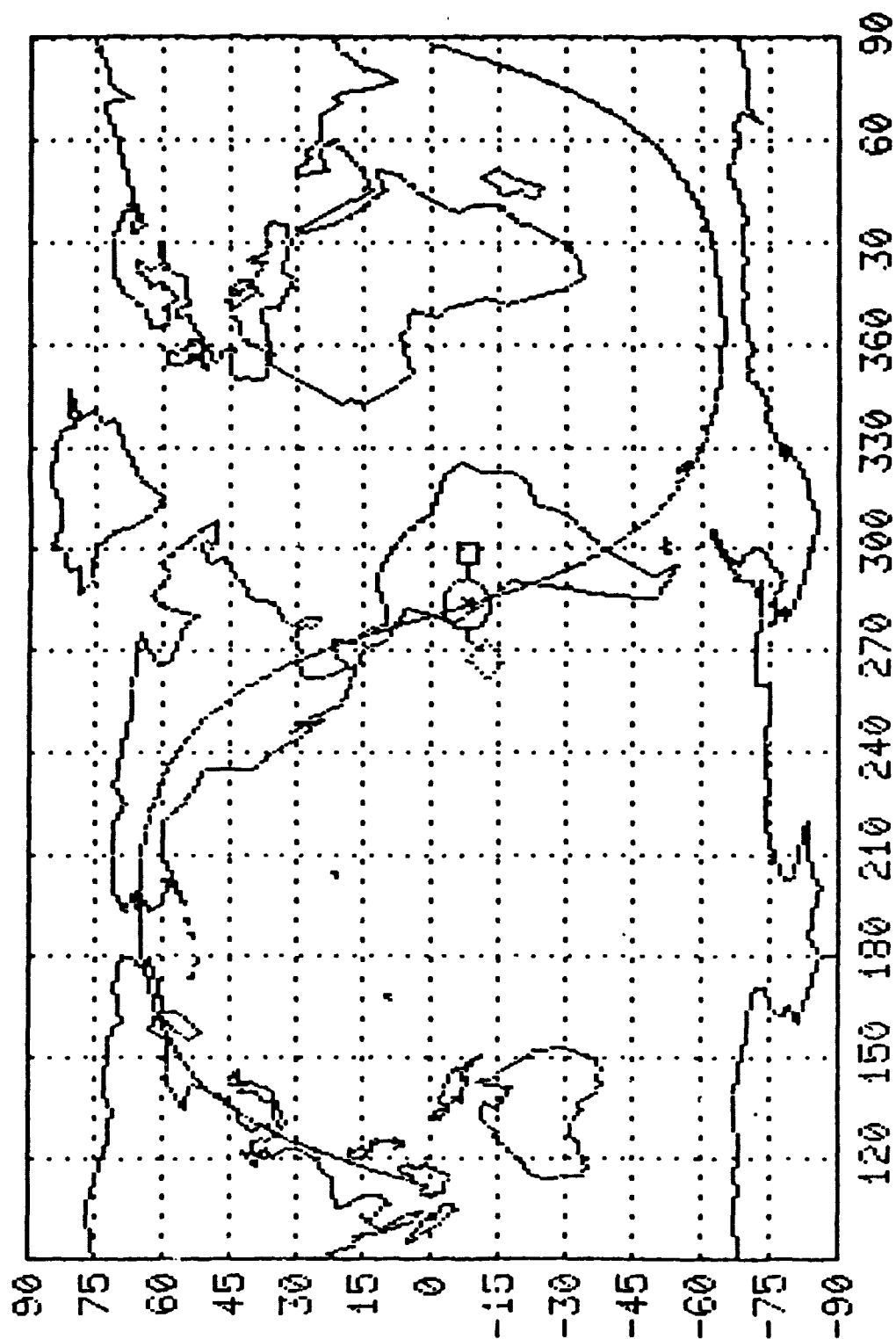
- Orbit data derived from element set #250 on satellite 8932.
- General shape; cylinder?
- Member of Cosmos 699 class.

CAUSE: Apparently deliberate fragmentation.

Scatter plot showing the relationship between Height of Apogee/Perigee (Y-axis) and Period (X-axis). The Y-axis ranges from 350 to 750, and the X-axis ranges from 92 to 98. Data points are marked with '+' and 'x'. The plot shows a general trend where Height of Apogee/Perigee increases with Period, with a notable cluster of points between 93 and 95 on the X-axis and 400 to 600 on the Y-axis. A few points are scattered at higher Y-values, up to 750.

1-166

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COSMOS 838

1976-67

COSMOS 839

9011

LAUNCH DATE: 8.88 Jul 1976

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 29 Sep 1977 (DAY 272)

TIME: 071647.3 GMT

LOCATION: 33 S/162 E

ALTITUDE: 1911 km

PIECES CATALOGED (1 JAN 84): 53

PIECES STILL IN ORBIT (1 JAN 84): 52

ORBIT CHARACTERISTICS:

INCLINATION: 65.85°

APOGEE: 2100 km

PERIGEE: 981 km

PERIOD: 116.9 min

TRUE ANOMALY: 226°

- COMMENTS:**
- Alleged Soviet ASAT target.
 - General shape was cylinder?; length 4 m?; dia. 2 m?
 - Did not break-up due to alleged ASAT test activity.
 - Orbit data derived from element set #379 for satellite 9011.

CAUSE: Unknown.

1976-67

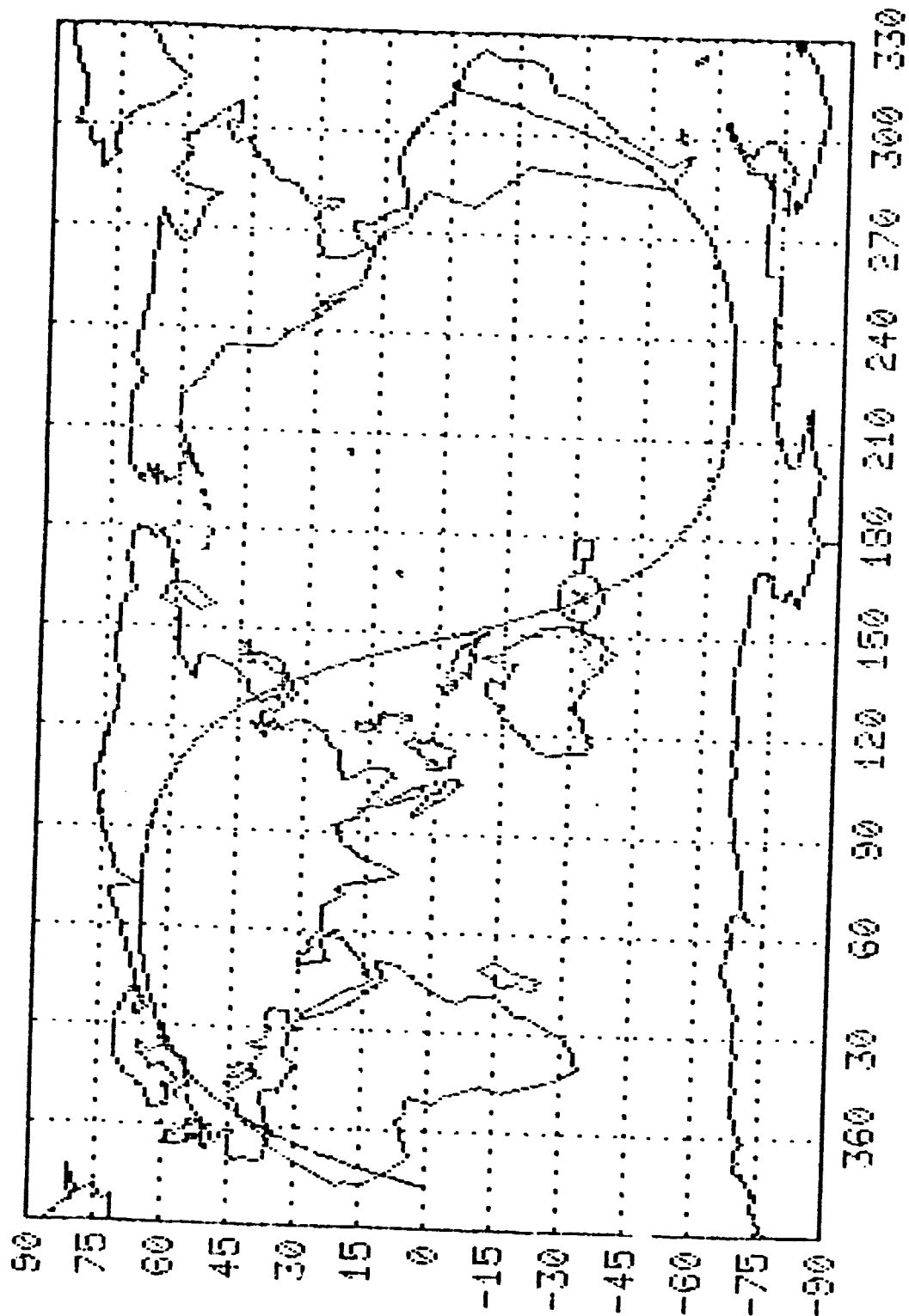
HEIGHT OF APOGEE/PERIGEE

PERIOD

HEIGHT OF APOGEE/PERIGEE	PERIOD
1100	109.5
1105	115.5
1110	115.5
1115	115.5
1120	115.5
1125	115.5
1130	115.5
1135	115.5
1140	115.5
1145	115.5
1150	115.5
1155	115.5
1160	115.5
1165	115.5
1170	115.5
1175	115.5
1180	115.5
1185	115.5
1190	115.5
1195	115.5
1200	115.5
1205	115.5
1210	115.5
1215	115.5
1220	115.5
1225	115.5
1230	115.5
1235	115.5
1240	115.5
1245	115.5
1250	115.5
1255	115.5
1260	115.5
1265	115.5
1270	115.5
1275	115.5
1280	115.5
1285	115.5
1290	115.5
1295	115.5
1300	115.5
1305	115.5
1310	115.5
1315	115.5
1320	115.5
1325	115.5
1330	115.5
1335	115.5
1340	115.5
1345	115.5
1350	115.5
1355	115.5
1360	115.5
1365	115.5
1370	115.5
1375	115.5
1380	115.5
1385	115.5
1390	115.5
1395	115.5
1400	115.5
1405	115.5
1410	115.5
1415	115.5
1420	115.5
1425	115.5
1430	115.5
1435	115.5
1440	115.5
1445	115.5
1450	115.5
1455	115.5
1460	115.5
1465	115.5
1470	115.5
1475	115.5
1480	115.5
1485	115.5
1490	115.5
1495	115.5
1500	115.5
1505	115.5
1510	115.5
1515	115.5
1520	115.5
1525	115.5
1530	115.5
1535	115.5
1540	115.5
1545	115.5
1550	115.5
1555	115.5
1560	115.5
1565	115.5
1570	115.5
1575	115.5
1580	115.5
1585	115.5
1590	115.5
1595	115.5
1600	115.5
1605	115.5
1610	115.5
1615	115.5
1620	115.5
1625	115.5
1630	115.5
1635	115.5
1640	115.5
1645	115.5
1650	115.5
1655	115.5
1660	115.5
1665	115.5
1670	115.5
1675	115.5
1680	115.5
1685	115.5
1690	115.5
1695	115.5
1700	115.5
1705	115.5
1710	115.5
1715	115.5
1720	115.5
1725	115.5
1730	115.5
1735	115.5
1740	115.5
1745	115.5
1750	115.5
1755	115.5
1760	115.5
1765	115.5
1770	115.5
1775	115.5
1780	115.5
1785	115.5
1790	115.5

1-170

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COSMOS 839

1976-72

COSMOS 844

9046

LAUNCH DATE: 22.66 Jul 1976

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 25 Jul 1976 (DAY 207)

TIME: 171754.7 GMT

LOCATION: 49 N/100 E

ALTITUDE: 209 km

PIECES CATALOGED (1 JAN 84): 248

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 67.15

APOGEE: 353 km

PERIGEE: 172 km

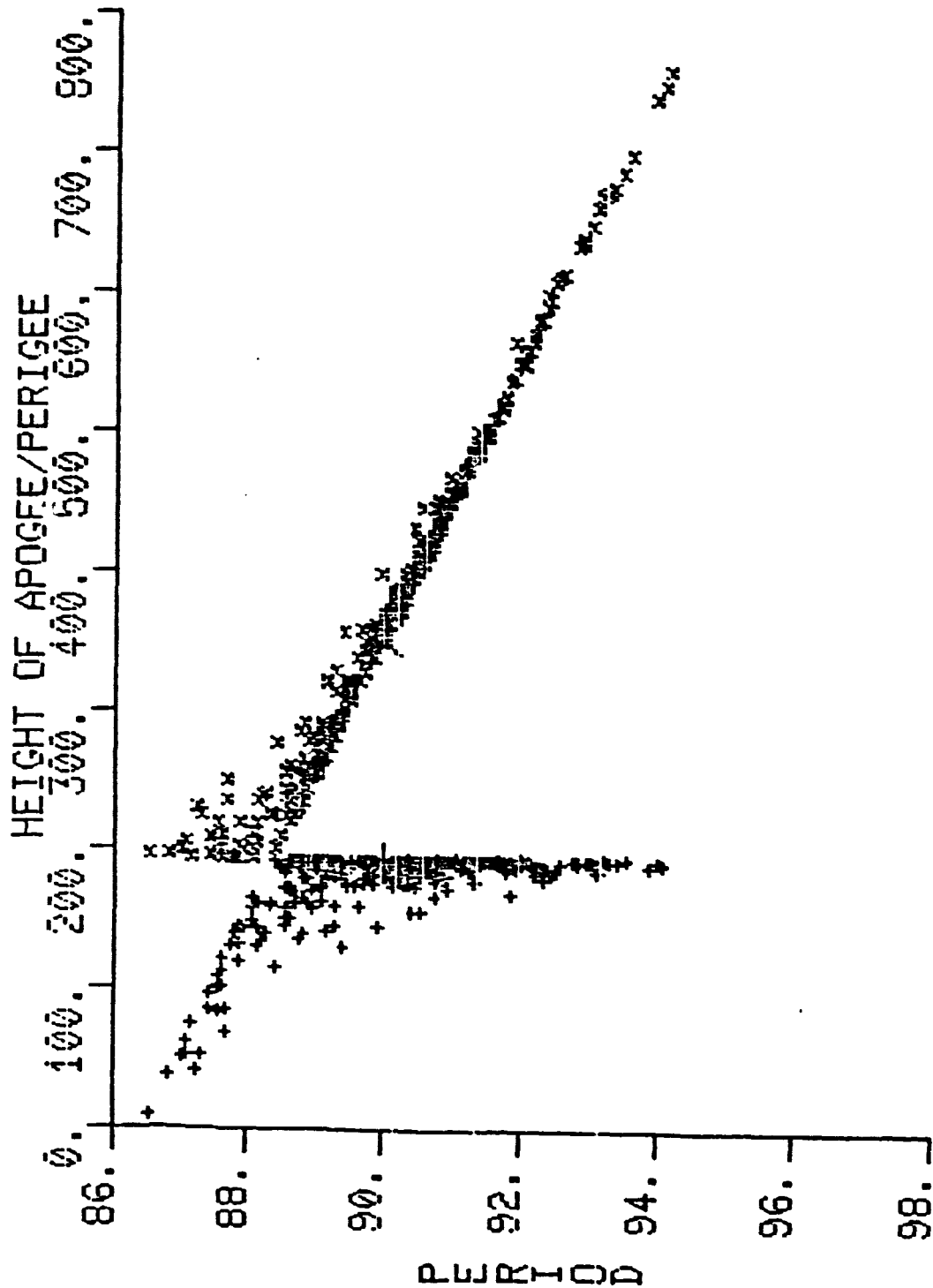
PERIOD: 89.8

TRUE ANOMALY: 55°

- COMMENTS:**
- Orbit data derived from element set #8 for satellite 9046.
 - All debris decayed before elements could be developed. Piece count approximation determined from sensors; satellite numbers assigned and each piece was designated "decayed" when cataloged. This procedure has not been consistent over the years, other satellites have fragmented in low orbit and all debris decayed before it could be cataloged but the pieces were not cataloged.
 - General shape was sphere-cylinder; length 7 m?; dia. 2.4 m; weight 6700 kg?

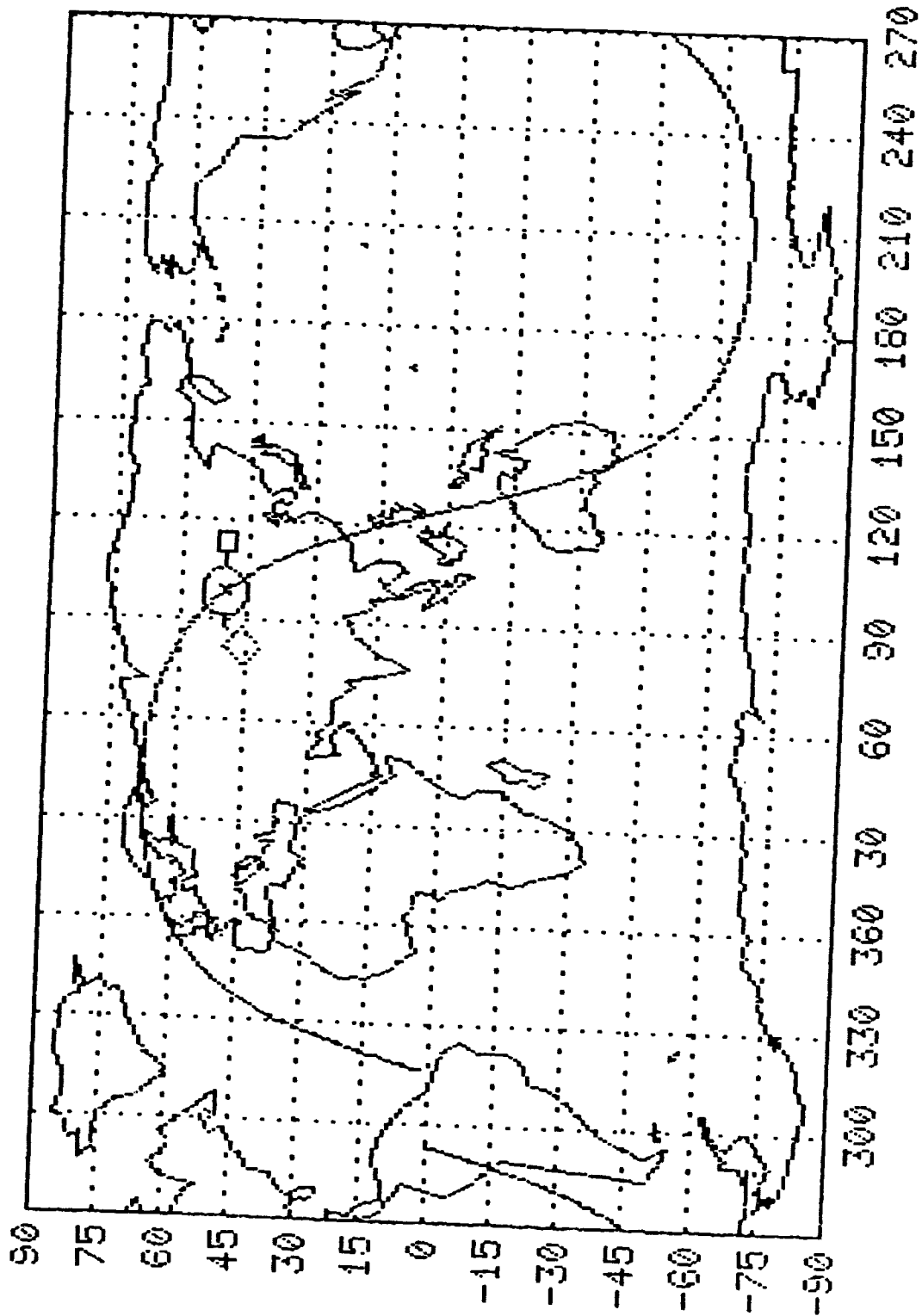
CAUSE: Probably deliberately detonated.

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COSMOS 844 SIMULATION

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COSMOS 844

1976-77

NOAA-5 (ITOS-H) R/B

9063

LAUNCH DATE: 29.71 Jul 1976

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 24 Dec 1977 (DAY 358)

TIME: 113324.7 GMT

LOCATION: 40 S/146 E

ALTITUDE: 1510 km

PIECES CATALOGED (1 JAN 84): 130

PIECES STILL IN ORBIT (1 JAN 84): 126

ORBIT CHARACTERISTICS:

INCLINATION: 102.02°

APOGEE: 1521 km

PERIGEE: 1506 km

PERIOD: 116.3 min

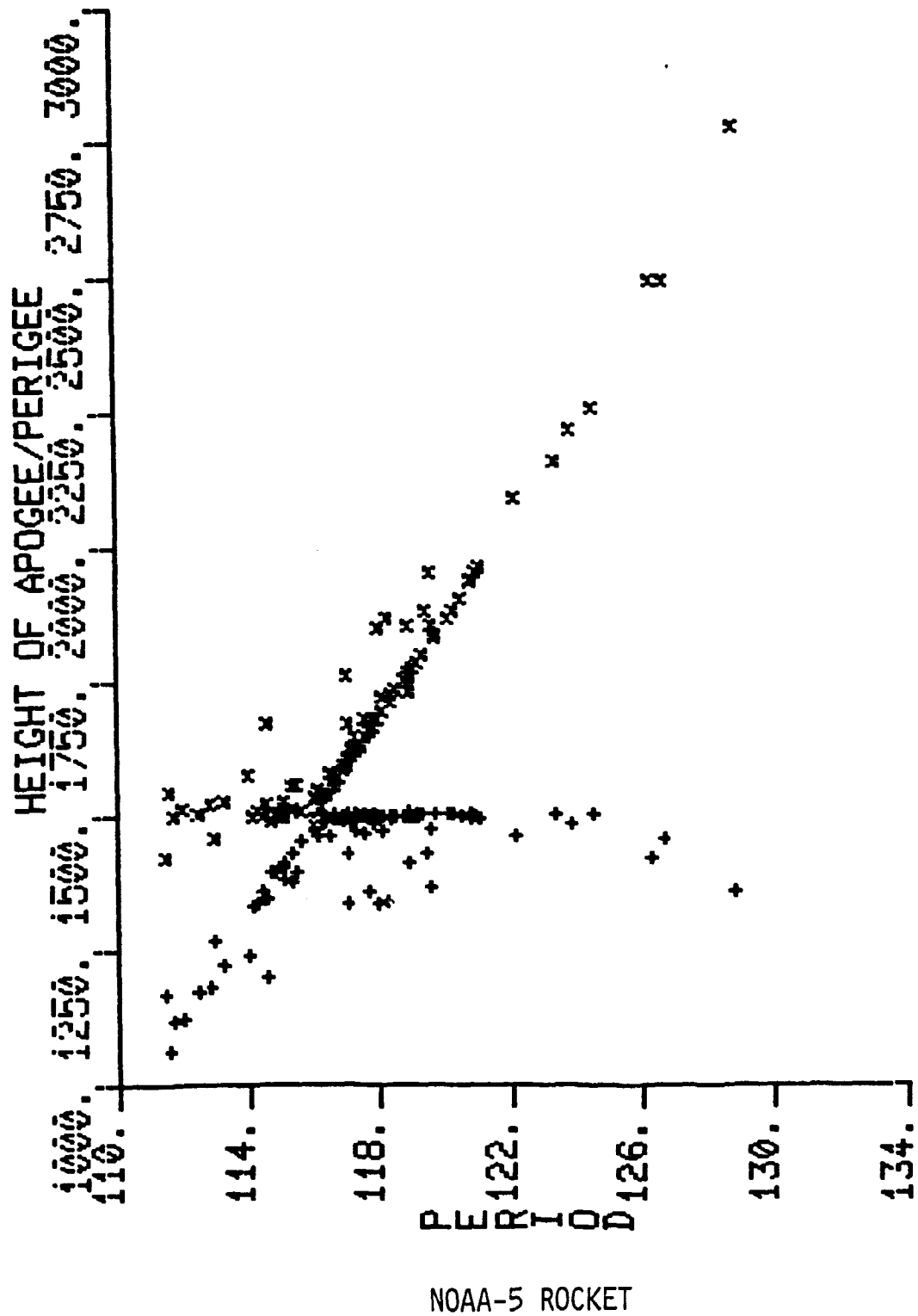
TRUE ANOMALY: 298°

COMMENTS:

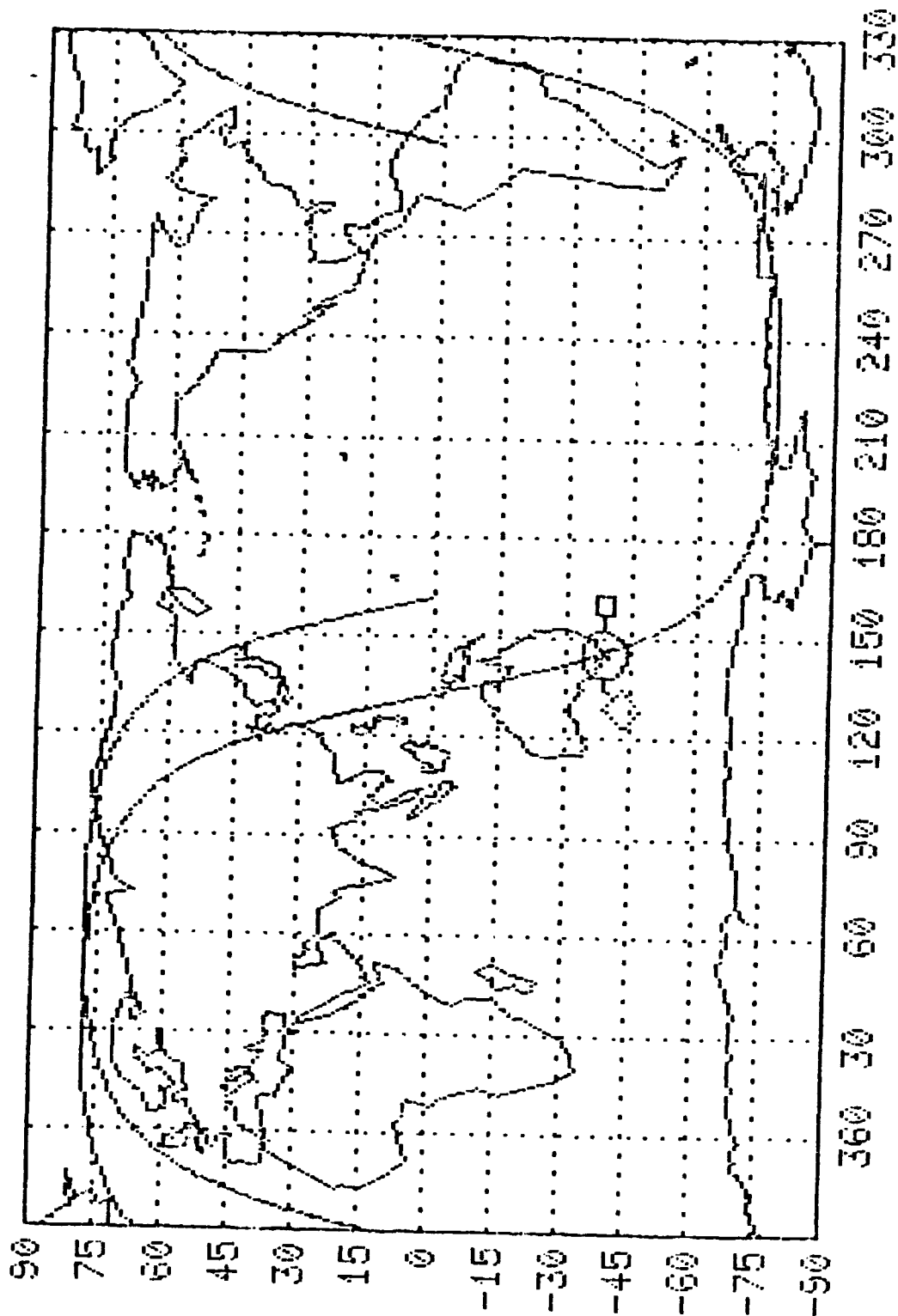
- Delta 2nd stage rocket.
- Orbit data derived from element set #97 for satellite 9063.
- General shape was cylinder plus annulus; length 6.4 m; dia. 1.52 and 2.44 m; weight 350 kg?

CAUSE: Hypergolic fuel ignition due to ruptured tank bulkhead most probable cause.

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NOAA-5 ITOS-H R/B

1976-105

COSMOS 862

9495

LAUNCH DATE: 22.39 Oct 1976

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 15 Mar 1977 (DAY 74)

TIME: 125626.1 GMT

LOCATION: 29 N/114 E

ALTITUDE: 5678 km

PIECES CATALOGED (1 JAN 84): 11

PIECES STILL IN ORBIT (1 JAN 84): 11

ORBIT CHARACTERISTICS:

INCLINATION: 63.16°

APOGEE: 39644 km

PERIGEE: 1352 km

PERIOD: 718.9 min

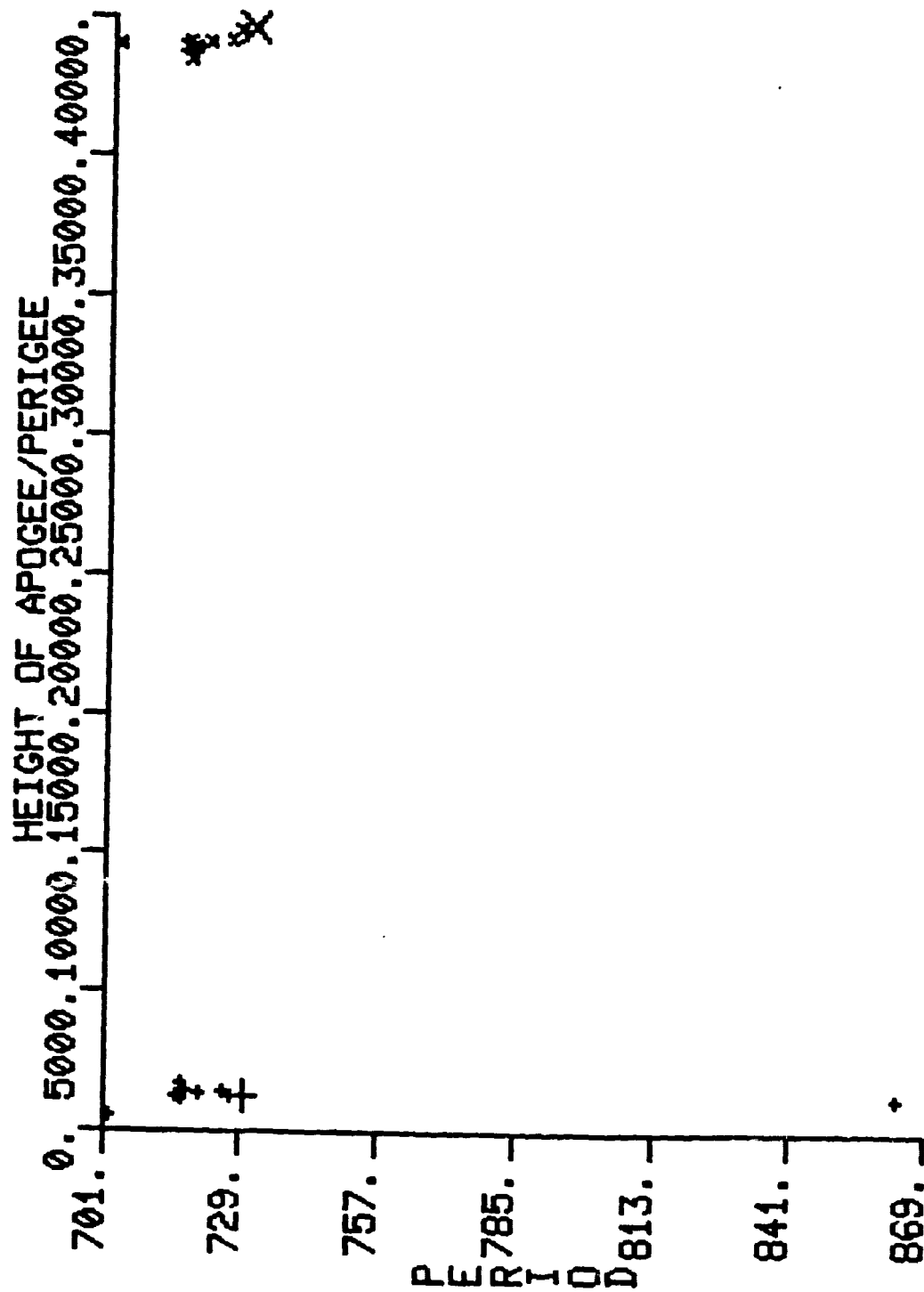
TRUE ANOMALY: 88°

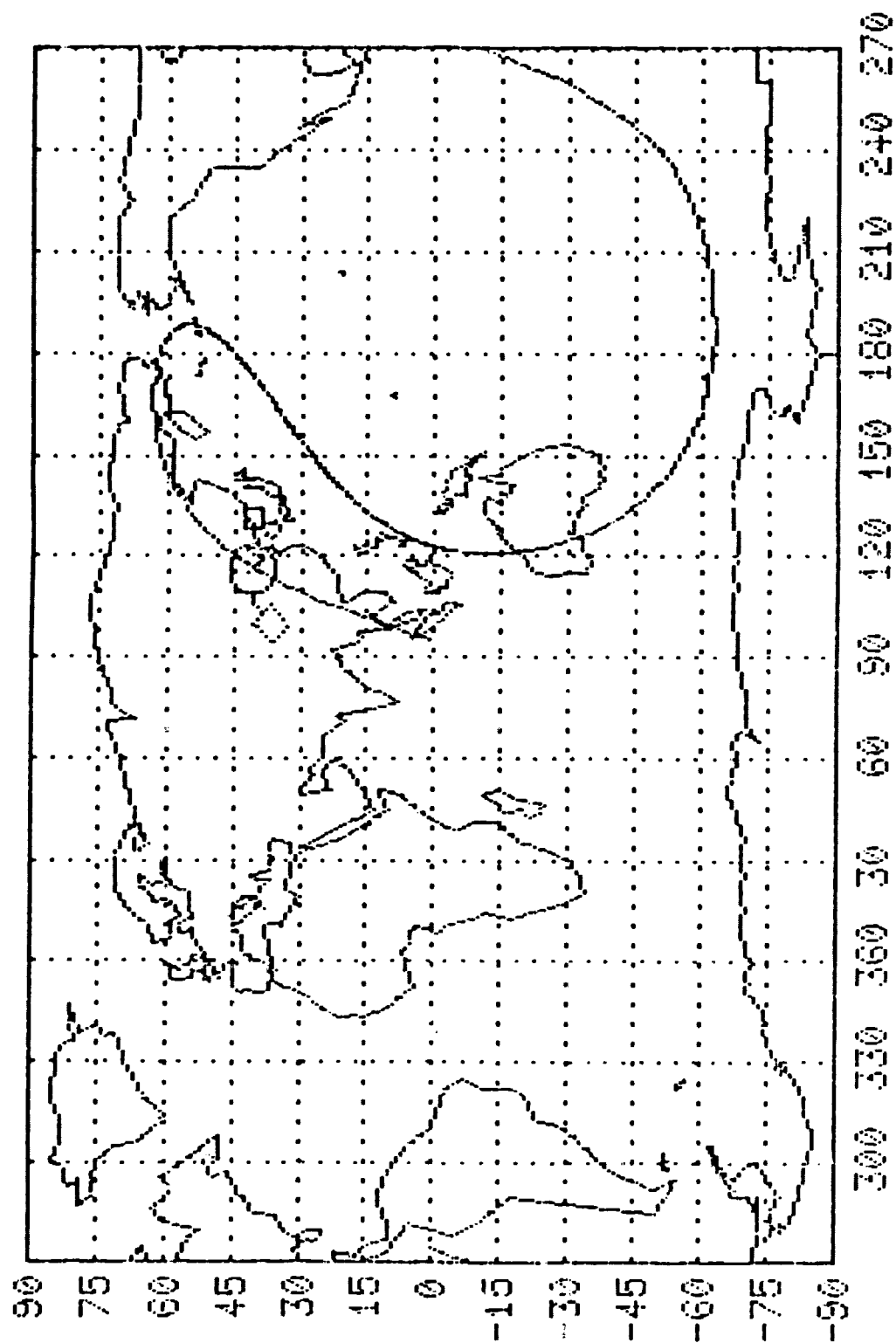
COMMENTS: • Orbit data derived from element set #46 for satellite 9495.

- General shape was windmill plus 6 vanes?; length 4.2 m?; dia. 1.6 m?; weight 1250 kg?

CAUSE: Unknown; first of many break-ups associated with this class of satellites.

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COSMOS 862

1976-120

COSMOS 880

9601

LAUNCH DATE: 9.84 Dec 1976

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 27 Nov 1978 (DAY 331)

TIME: 170248.3 GMT

LOCATION: 65 S/306 E

ALTITUDE: 559 km

PIECES CATALOGED (1 JAN 84): 50

PIECES STILL IN ORBIT (1 JAN 84): 13

ORBIT CHARACTERISTICS:

INCLINATION: 65.84°

APOGEE: 621 km

PERIGEE: 551 km

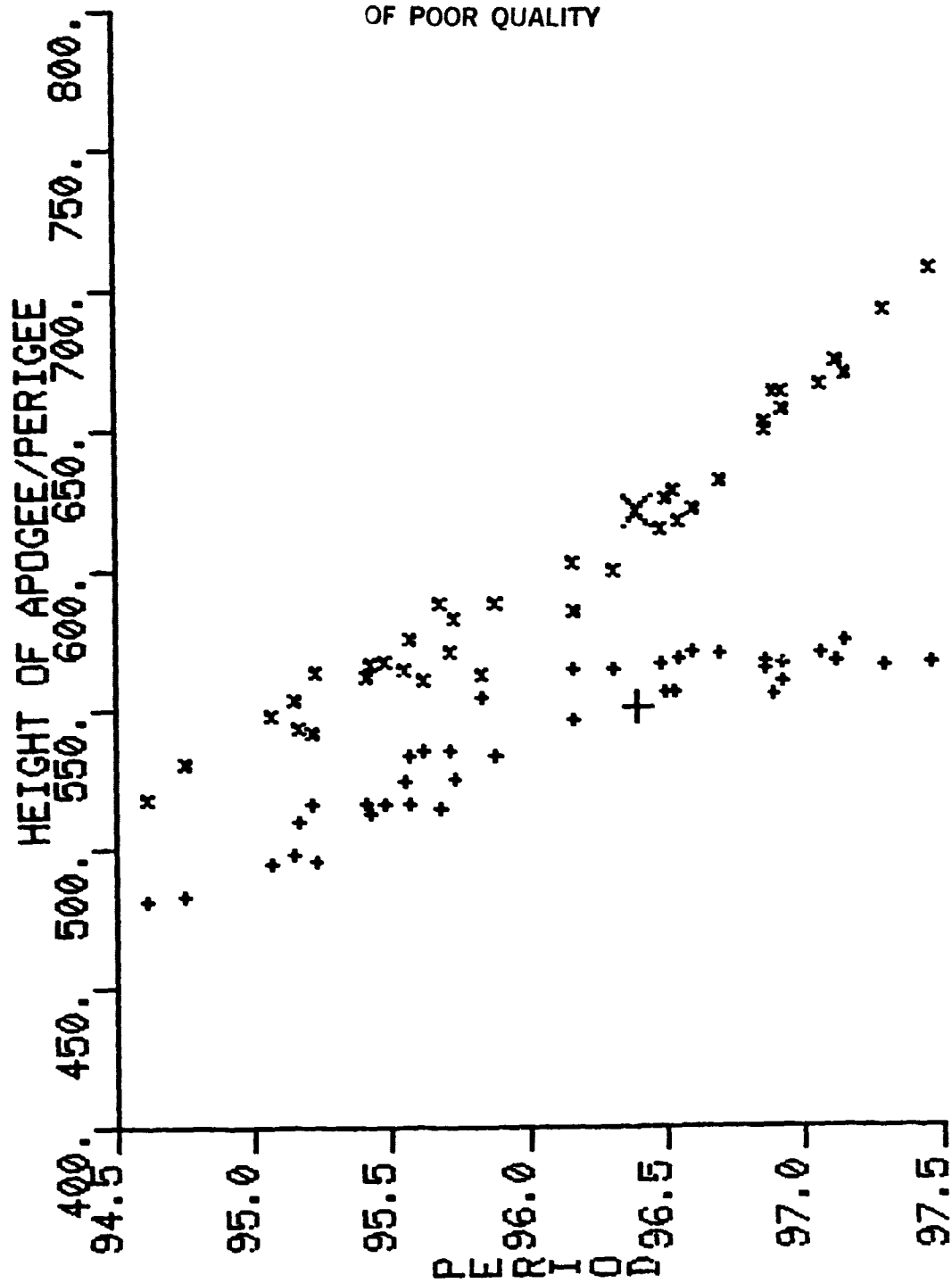
PERIOD: 96.4 min

TRUE ANOMALY: 321°

- COMMENTS:**
- General shape was cylinder?; length 4 m?; dia. 2 m?
 - Orbit characteristics derived from element set #403 for satellite 9601.
 - This apparent ASAT target did not fragment due to alleged ASAT test activity.

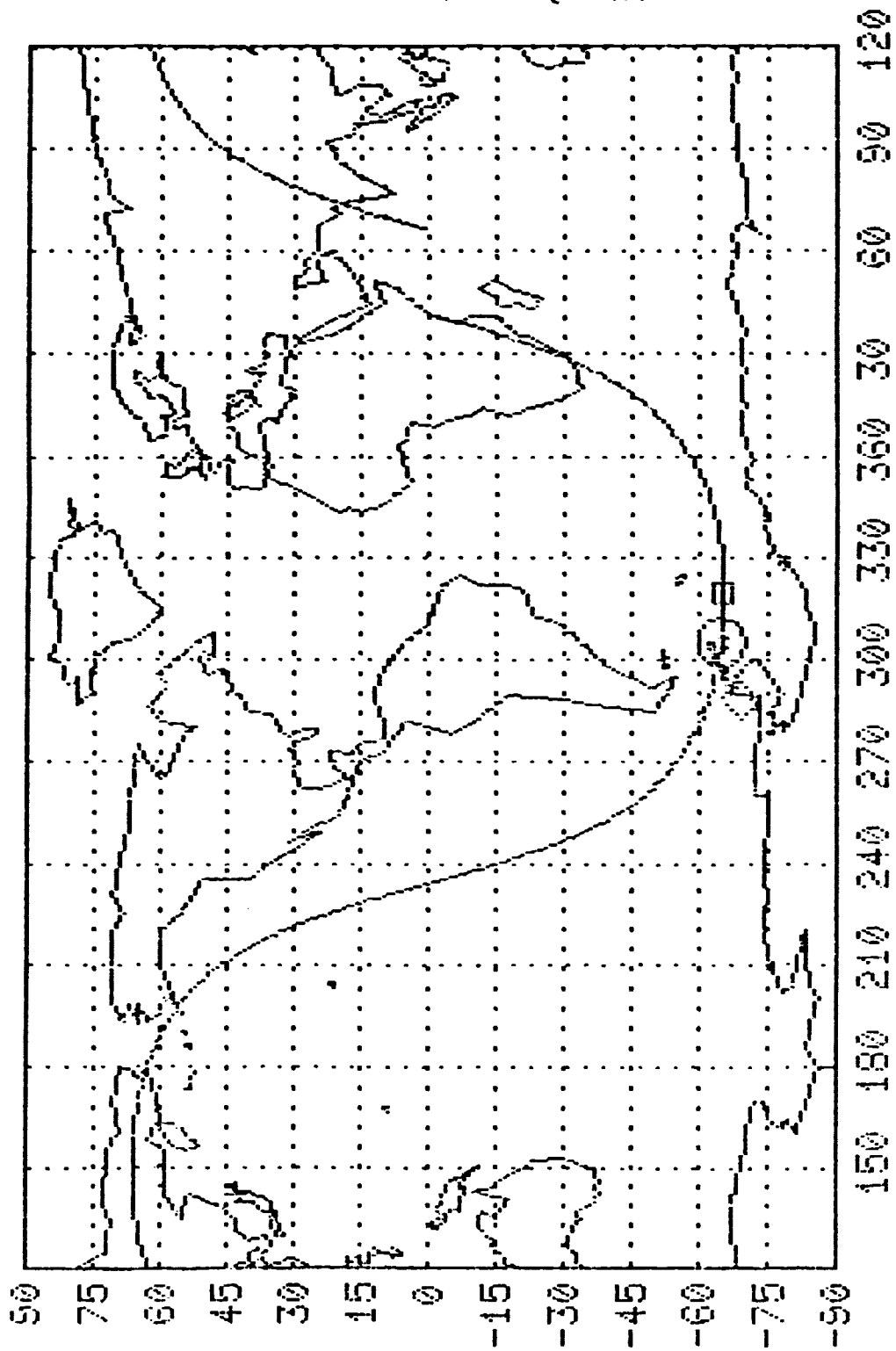
CAUSE: Unknown.

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COSMOS 880

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COSMOS 880

1976-126

COSMOS 886

9634

LAUNCH DATE: 27.53 Dec 1976

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 27 Dec 1976 (DAY 362)

TIME: 183955.7 GMT

LOCATION: 65 S/211 E

ALTITUDE: 2088 km

PIECES CATALOGED (1 JAN 84): 57

PIECES STILL IN ORBIT (1 JAN 84): 51

ORBIT CHARACTERISTICS:

INCLINATION: 65.84°

APOGEE: 2297 km

PERIGEE: 595 km

PERIOD: 114.8 min

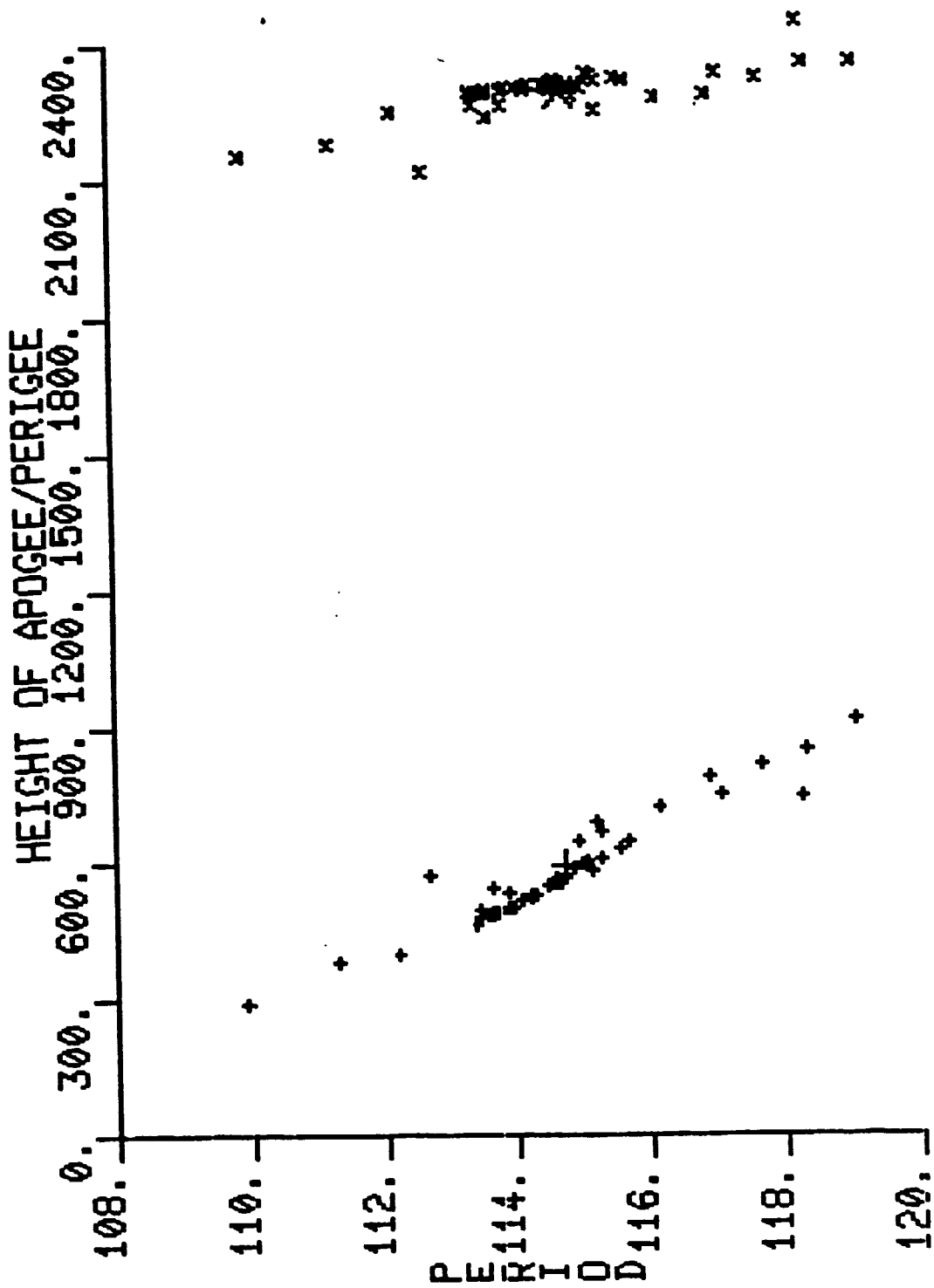
TRUE ANOMALY: 217°

- COMMENTS:**
- Alleged Soviet ASAT test.
 - General shape was cylinder?; length 4 m?; dia. 2m?
 - Orbit data derived from element set #2 for satellite 9634.
 - Fragmentation did not occur near the alleged target satellite (Kosmos 880).

CAUSE: Fragmentation due to alleged ASAT test activity.

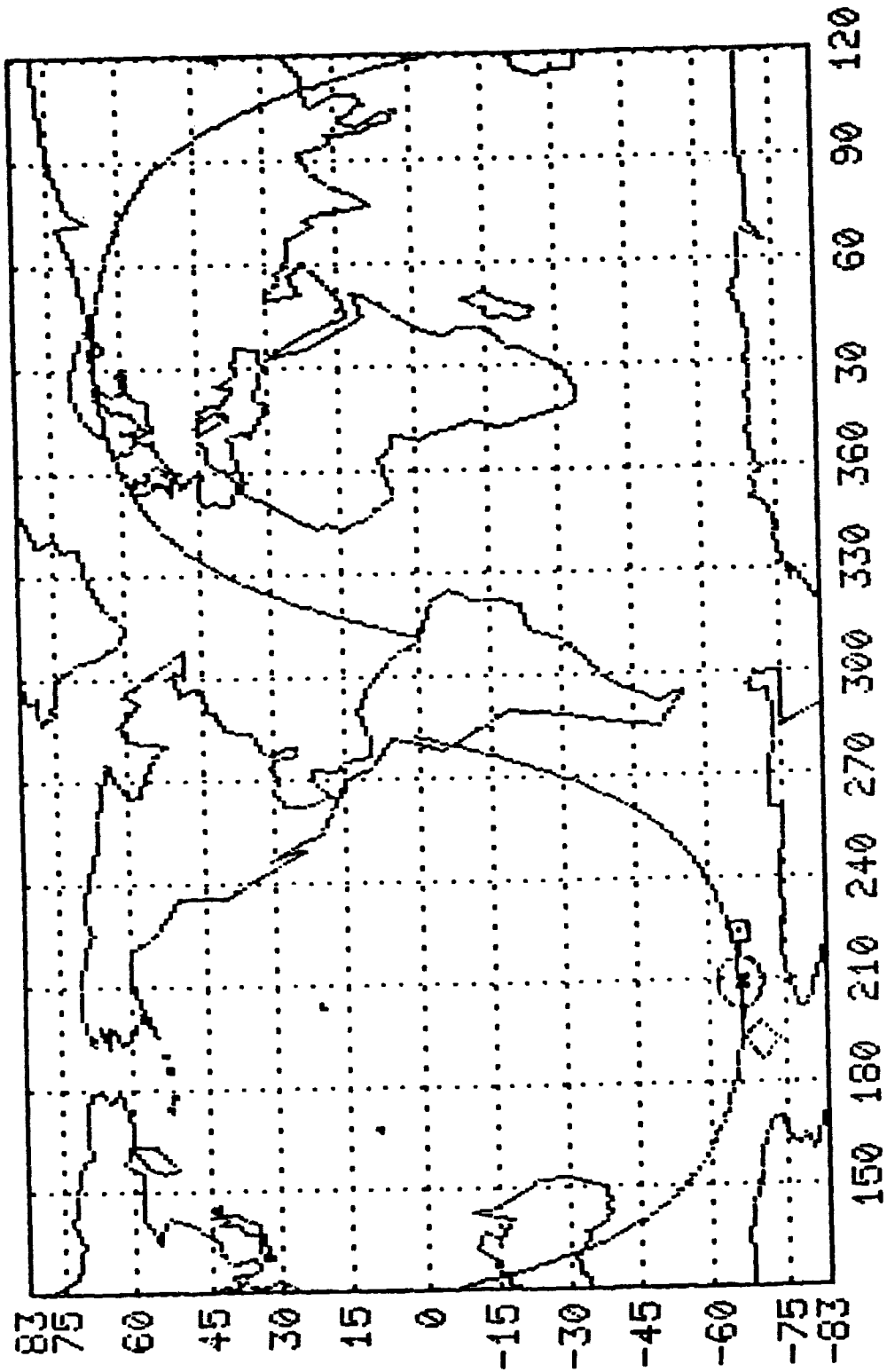
1976-126

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COSMOS 886

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COSMOS 886

1977-27

COSMOS 903

9911

LAUNCH DATE: 11.07 Apr 1977

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 8 Jun 1978 (DAY 159)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 2

PIECES STILL IN ORBIT (1 JAN 84): 2

ORBIT CHARACTERISTICS:

INCLINATION: 63.15°

APOGEE: 39035 km

PERIGEE: 1323 km

PERIOD: 717.8 min

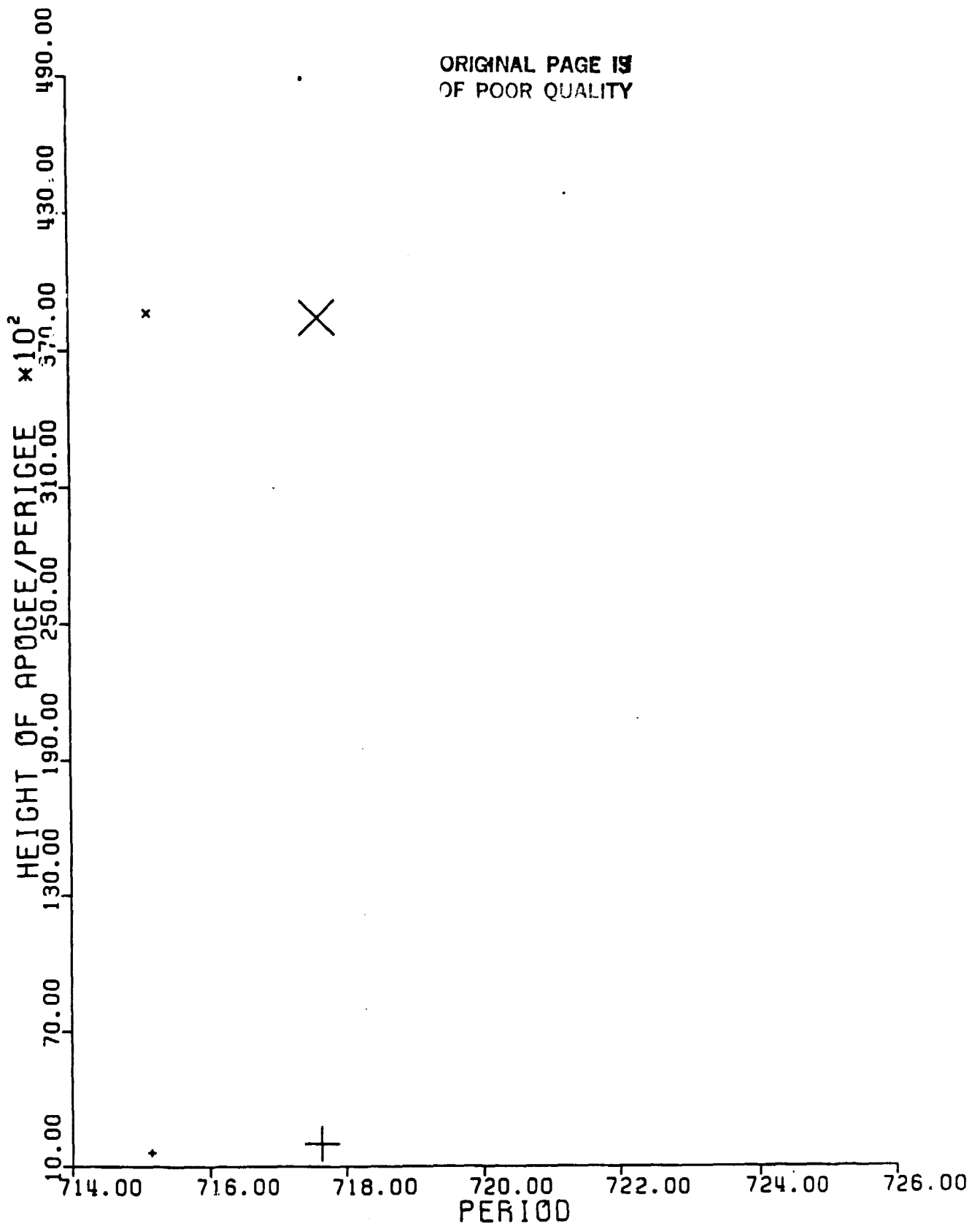
TRUE ANOMALY:

COMMENTS:

- General shape was windmill plus 6 vanes?; length 4.2 m?; dia. 1.6 m?; weight 1250 kg?
- Orbit data derived from element set #84 for satellite 9911.
- Insufficient data is available to determine time and location for the satellite 9911 event.

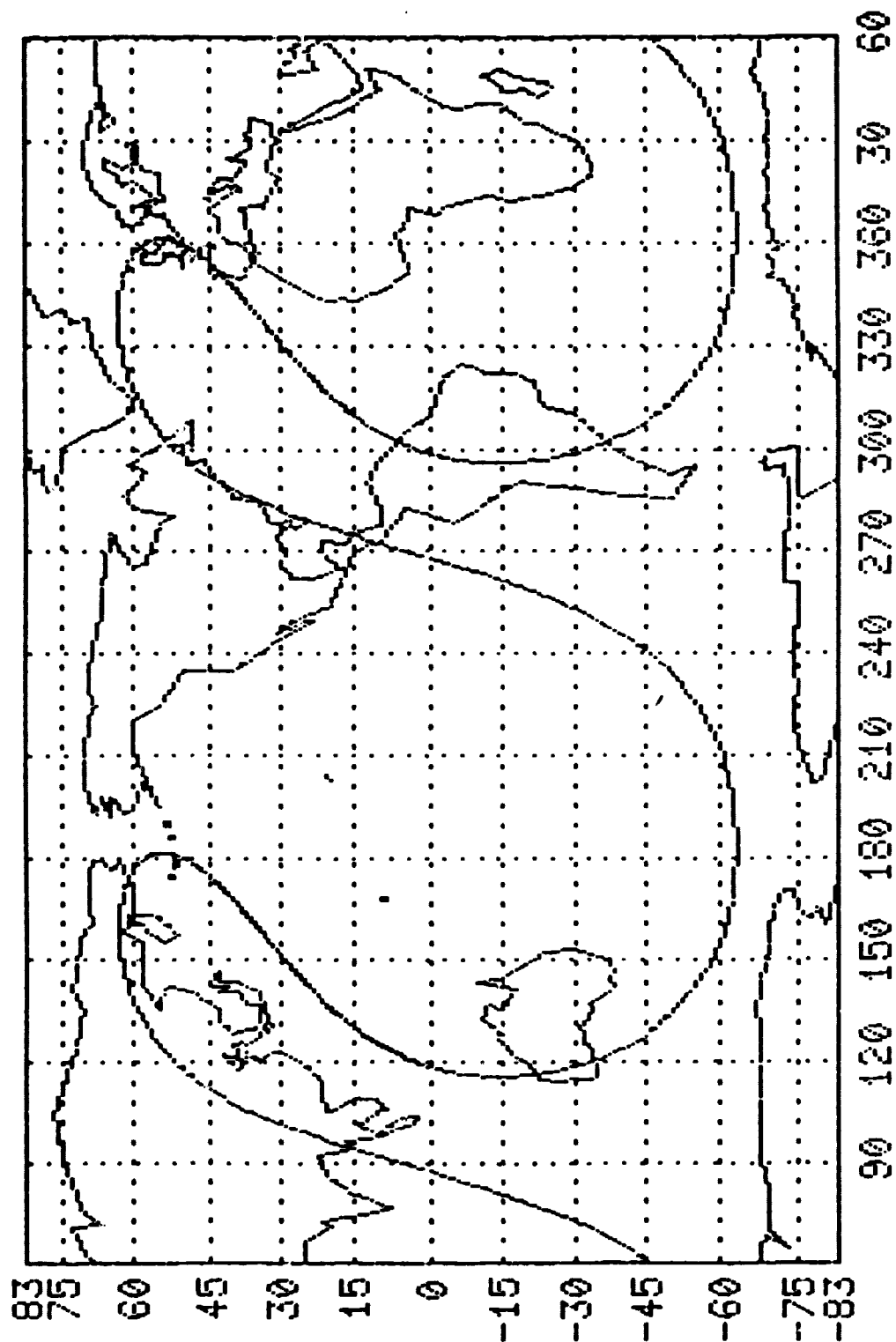
CAUSE: Unknown.

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COSMOS 903

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COSMOS 903

1977-47

COSMOS 917

10059

LAUNCH DATE: 16.09 Jun 1977

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 30 Mar 1979 (DAY 89)

TIME: 154507.4 GMT

LOCATION: 63 S/O E

ALTITUDE: 3283 km

PIECES CATALOGED (1 JAN 84): 1

PIECES STILL IN ORBIT (1 JAN 84): 1

ORBIT CHARACTERISTICS:

INCLINATION: 62.95°

APOGEE: 38723 km

PERIGEE: 1643 km

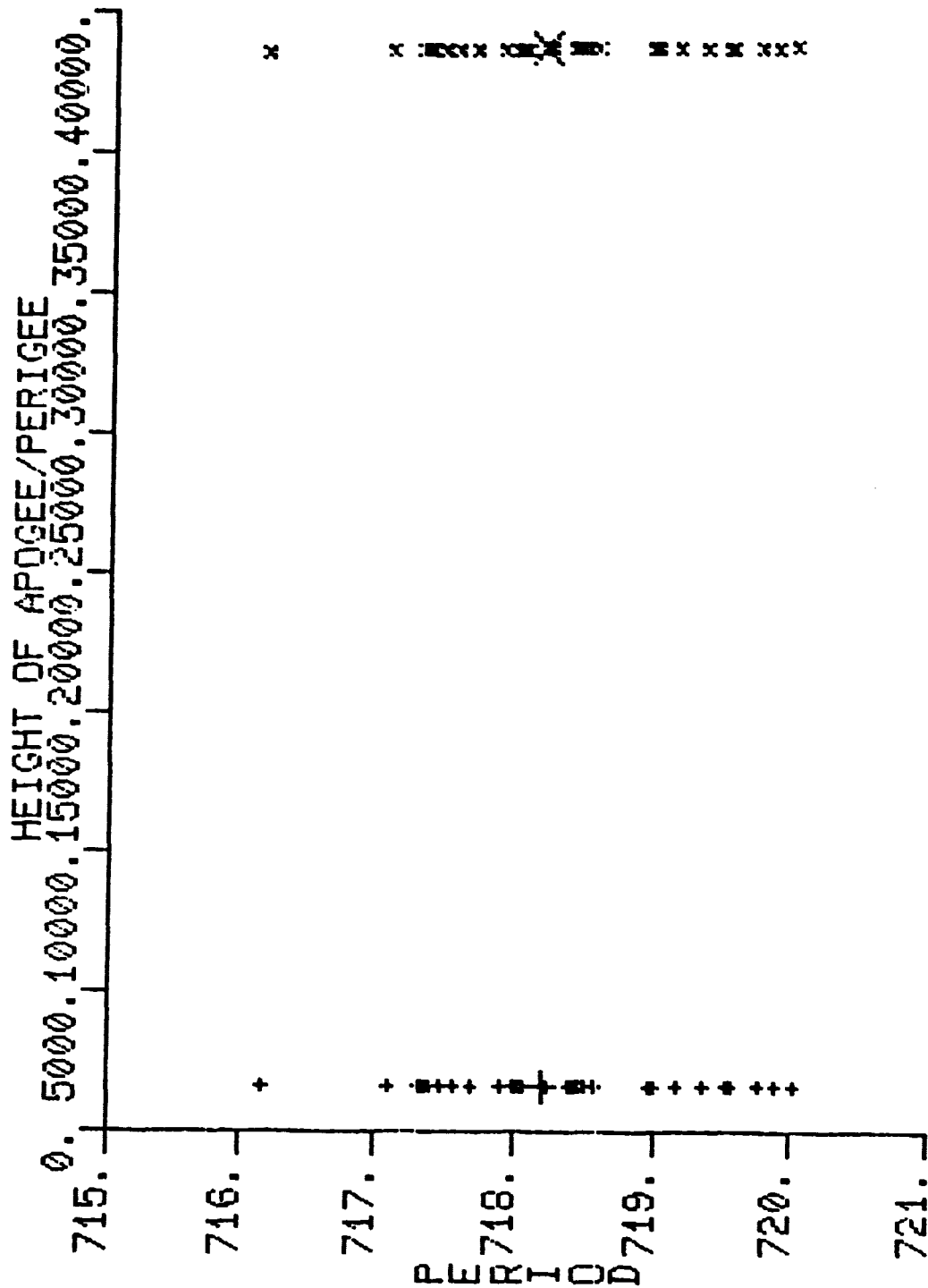
PERIOD: 718.0 min

TRUE ANOMALY: 306°

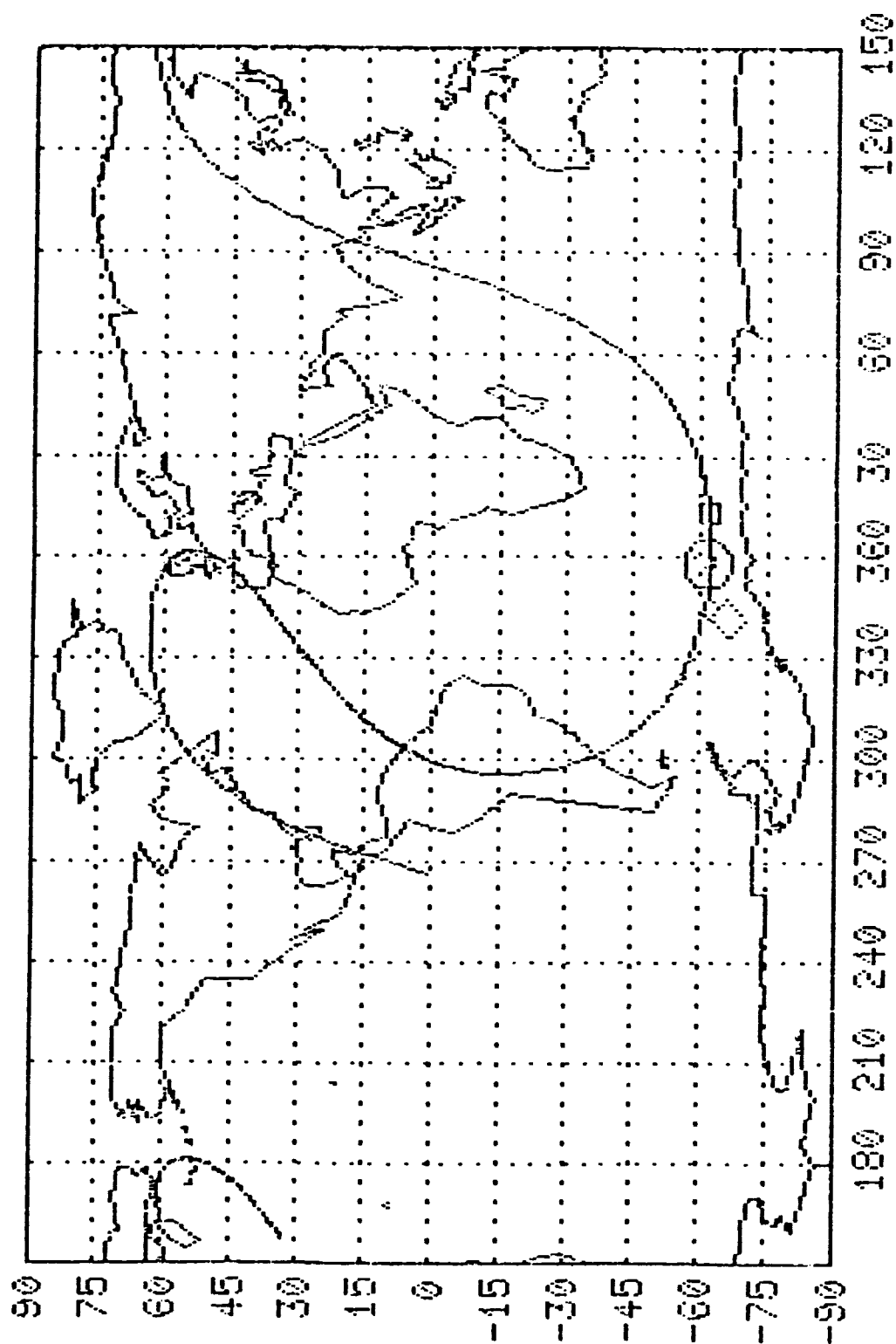
- COMMENTS:**
- General shape was windmill plus 6 vanes?; length 4.2 m?; dia. 1.6 m; weight 1250 kg?
 - Orbit data derived from element set #134 for satellite 10059.

CAUSE: Unknown.

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COSMOS 917

1977-65

HIMAWARI R/B

10144

LAUNCH DATE: 14.44 Jul 1977

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 14 Jul 1977 (DAY 195)

TIME: 161155.1 GMT

LOCATION: 14 N/249 E

ALTITUDE: 1450 km

PIECES CATALOGED (1 JAN 84): 147

PIECES STILL IN ORBIT (1 JAN 84): 93

ORBIT CHARACTERISTICS:

INCLINATION: 29.05°

APOGEE: 2027 km

PERIGEE: 536 km

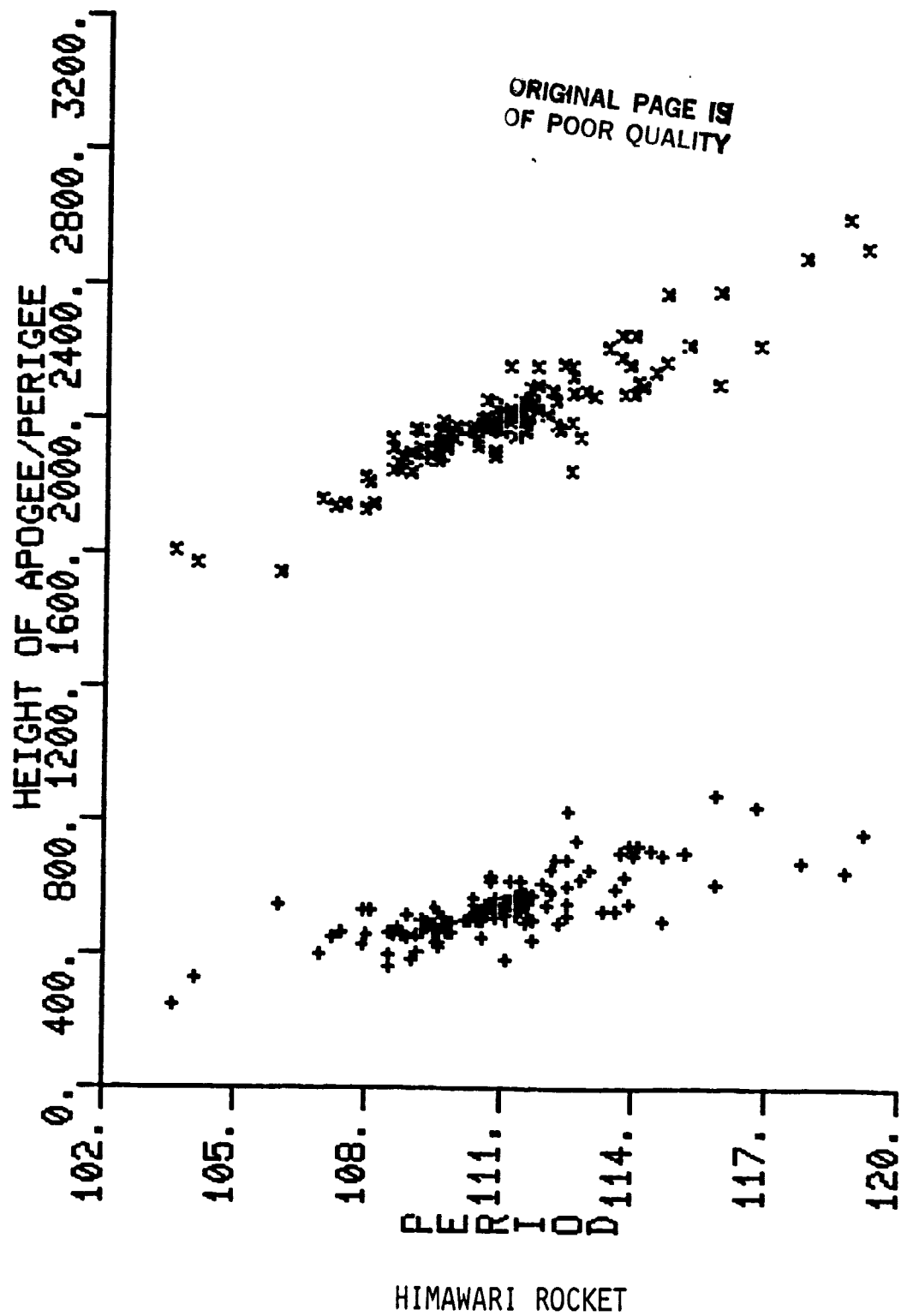
PERIOD: 111.2 min

TRUE ANOMALY: 108°

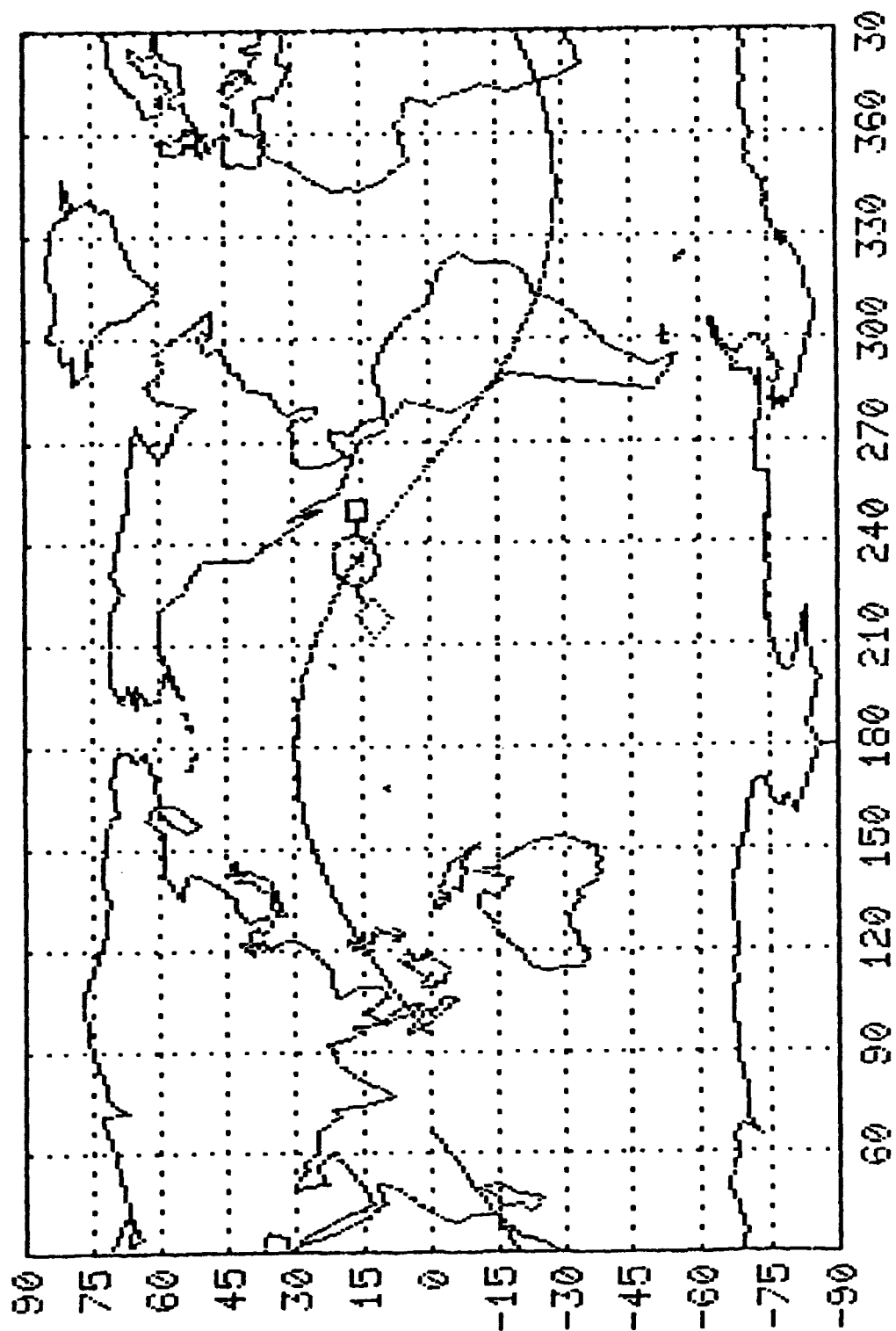
COMMENTS: • Delta 2nd stage rocket.

- Orbit data derived from element set #2 for satellite 10144.
- General shape was cylinder; length 3 m; dia. 2.1 m?; weight 670 kg full, 281 kg empty.

CAUSE: Hypergolic fuel ignition due to ruptured tank bulkhead most probable cause.



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HIMAWARI R/B

1977-68

COSMOS 931

10150

LAUNCH DATE: 20.20 Jul 1977

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 24 Oct 1977 (DAY 297)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 4

PIECES STILL IN ORBIT (1 JAN 84): 2

ORBIT CHARACTERISTICS:

INCLINATION: 62.94°

APOGEE: 39667 km

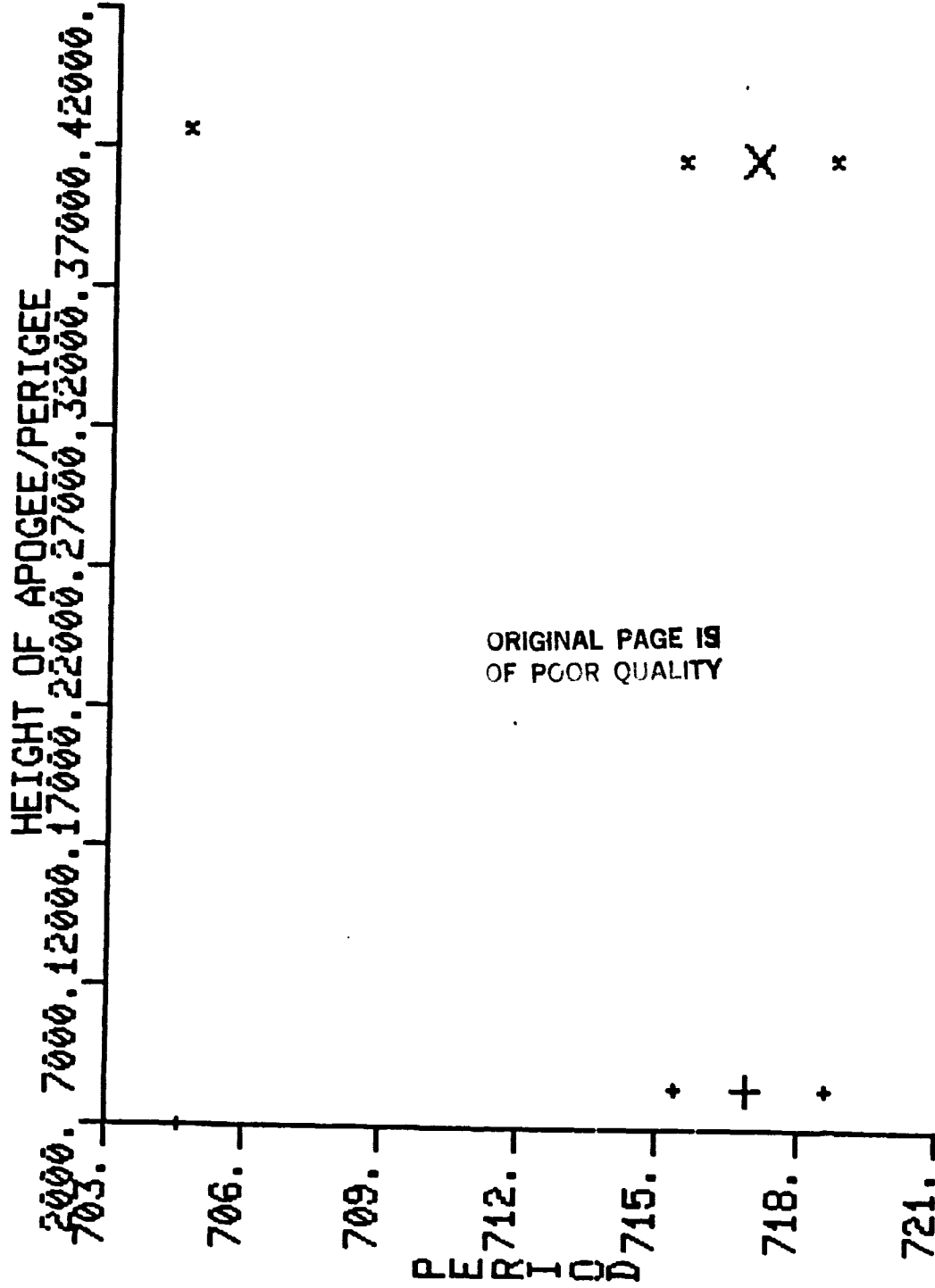
PERIGEE: 682 km

PERIOD: 717.7 min

TRUE ANOMALY:

- COMMENTS:**
- General shape was windmill plus 6 vanes?; length 4.2 m?; dia. 1.6 m?; weight 1250 kg.
 - Orbit data derived from element set #16 for satellite 10150.

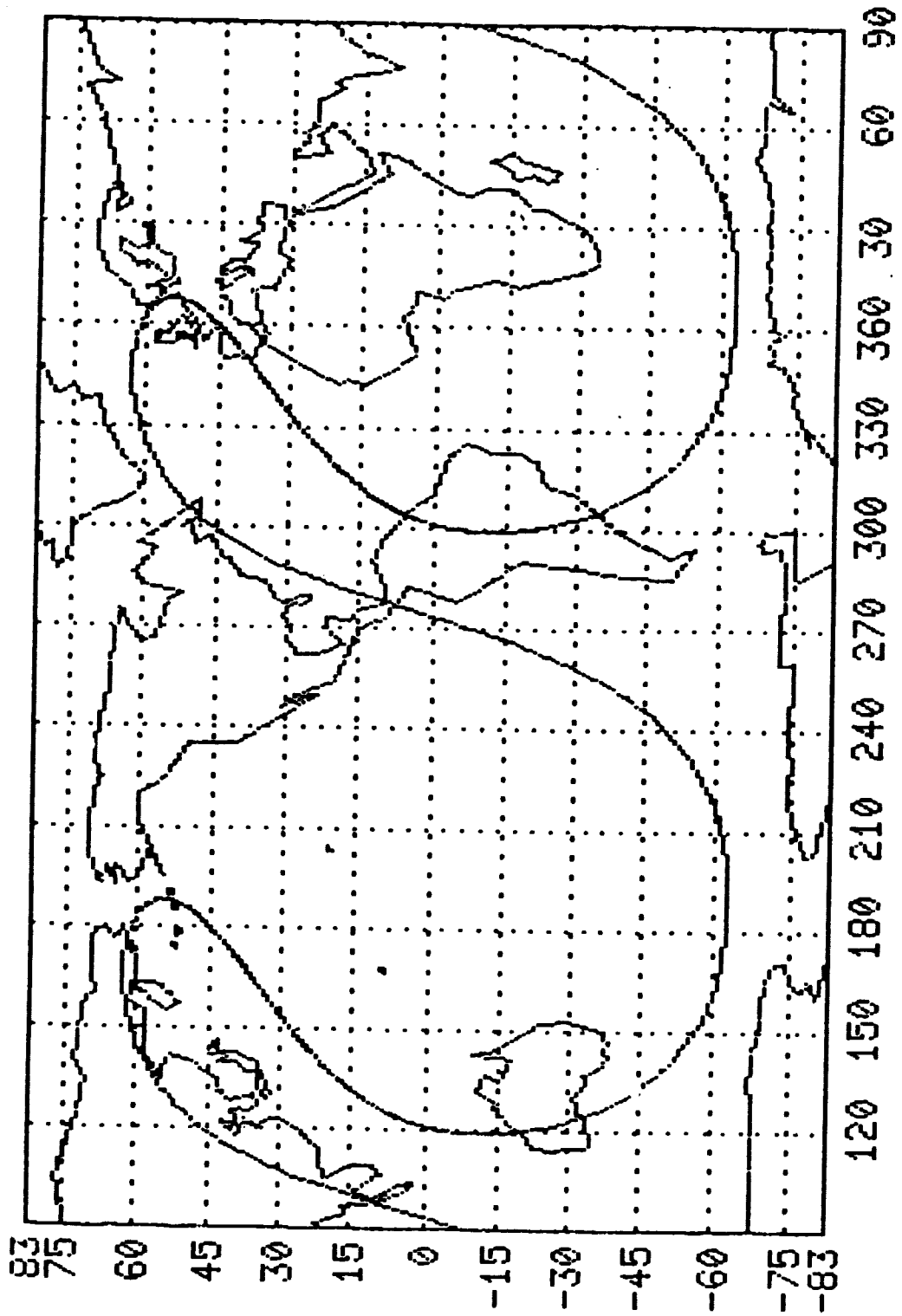
CAUSE: Unknown.



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COSMOS 931

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COSMOS 931

1977-121

COSMOS 970

10531

LAUNCH DATE: 21.44 Dec 1977

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 21 Dec 1977 (DAY 355)

TIME: 170946.4 GMT

LOCATION: 38 S/274 E

ALTITUDE: 1133 km

PIECES CATALOGED (1 JAN 84): 54

PIECES STILL IN ORBIT (1 JAN 84): 54

ORBIT CHARACTERISTICS:

INCLINATION: 65.85°

APOGEE: 1139 km

PERIGEE: 946 km

PERIOD: 106.0 min

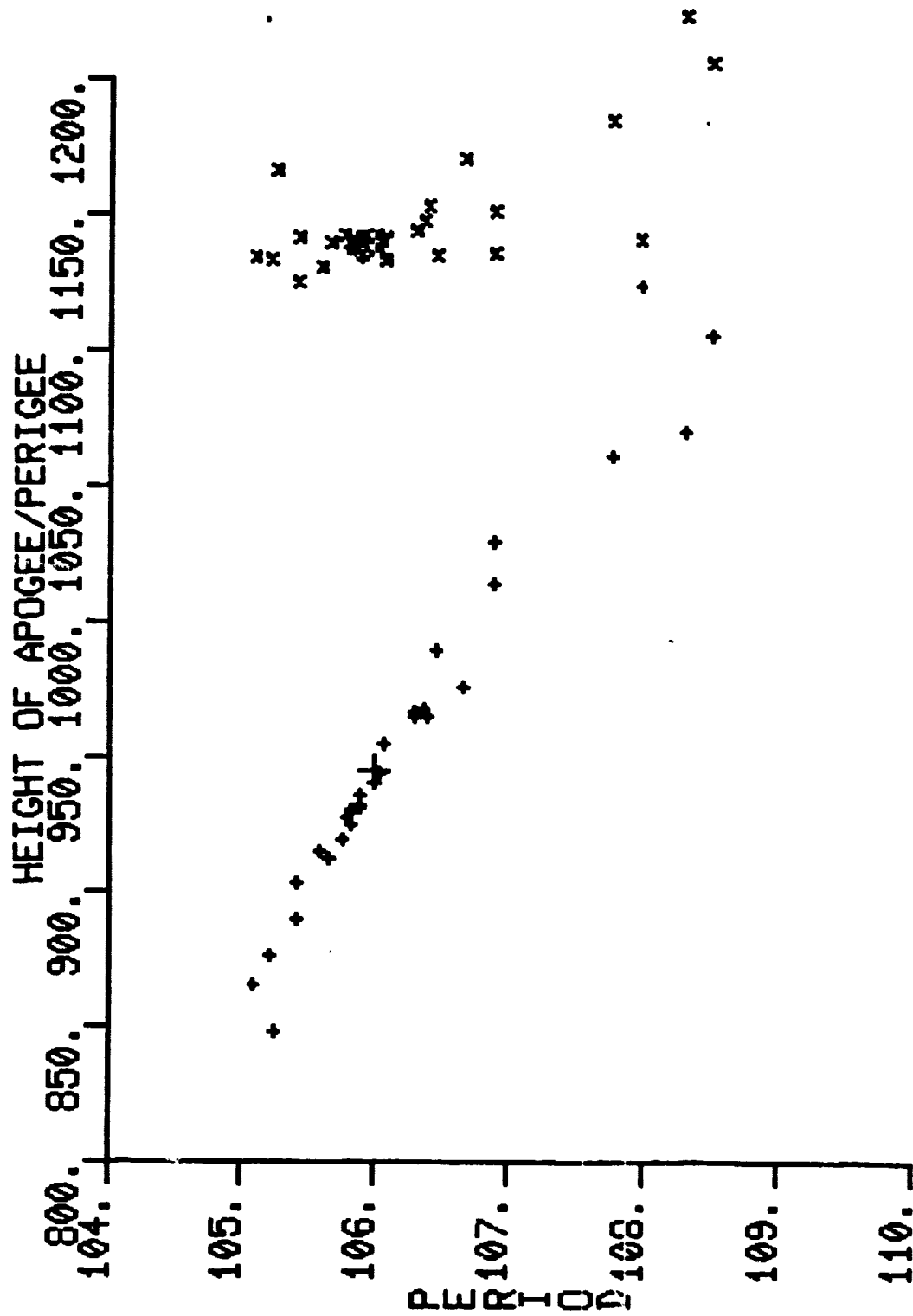
TRUE ANOMALY: 201°

COMMENTS:

- Alleged Soviet ASAT test.
- General shape was cylinder?; length 4 m; dia. 2m?
- Orbit data derived from element set #6 for satellite 10531.

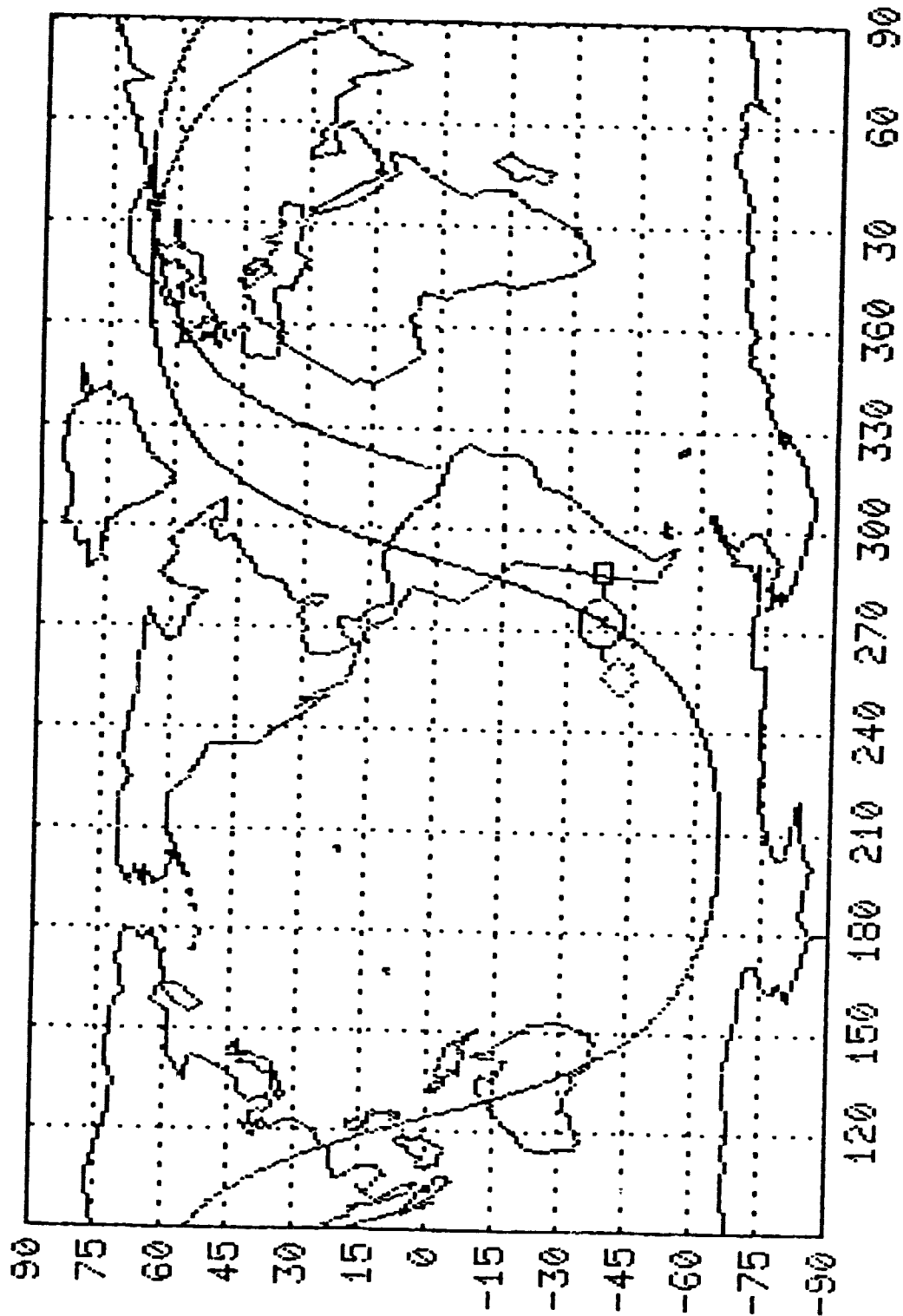
CAUSE: Fragmentation due to alleged ASAT test activity.

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CGSMOS 970

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COSMOS 970

1978-26

LANDSAT 3 R/B

10704

LAUNCH DATE: 5.75 Mar 1978

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 27 Jan 1981 (DAY 27)

TIME: 043202.3 GMT

LOCATION: 80 S/301 E

ALTITUDE: 905 km

PIECES CATALOGED (1 JAN 84): 172

PIECES STILL IN ORBIT (1 JAN 84): 155

ORBIT CHARACTERISTICS:

INCLINATION: 98.85°

APOGEE: 912 km

PERIGEE: 903 km

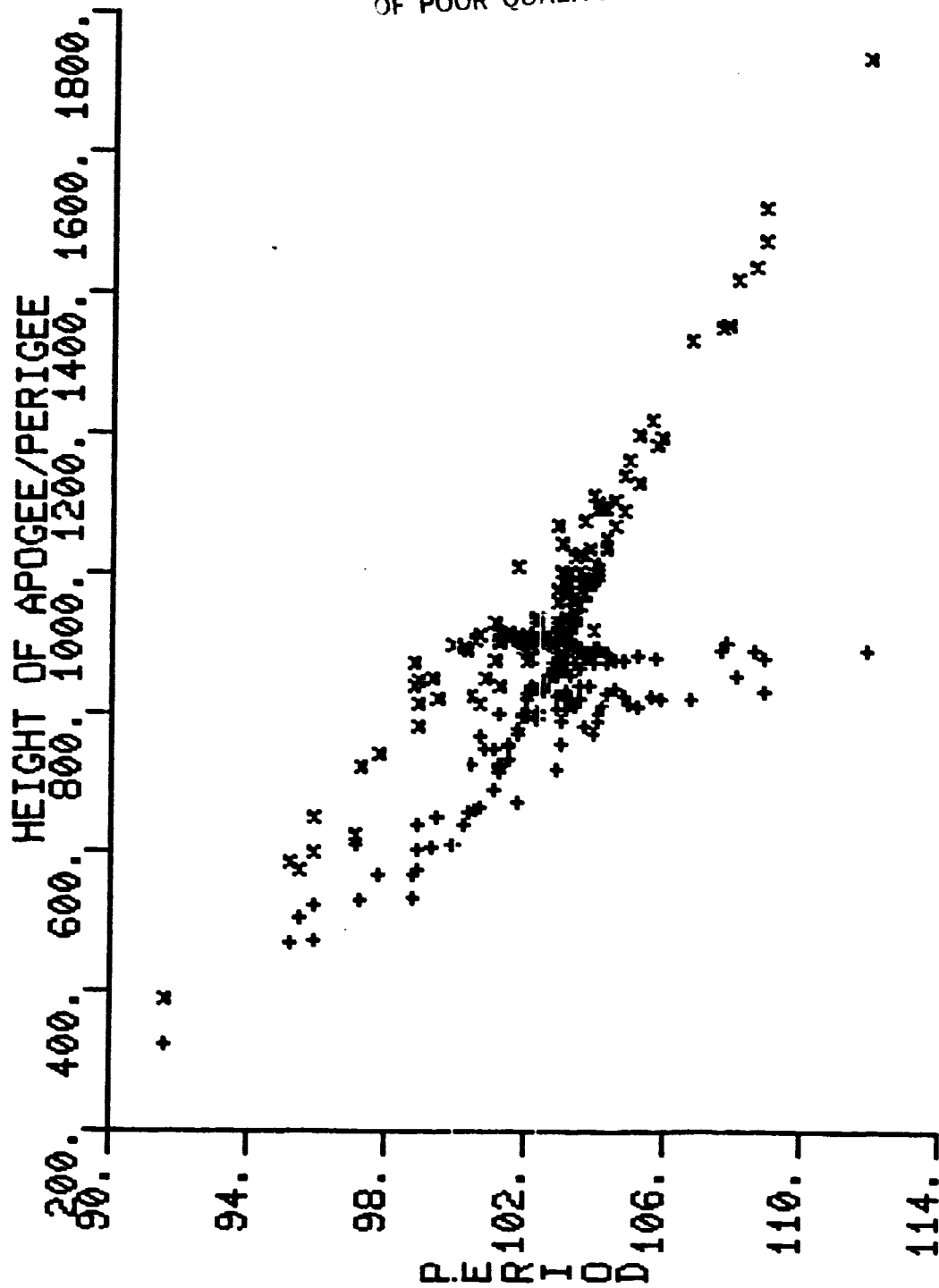
PERIOD: 103.1 min

TRUE ANOMALY: 62°

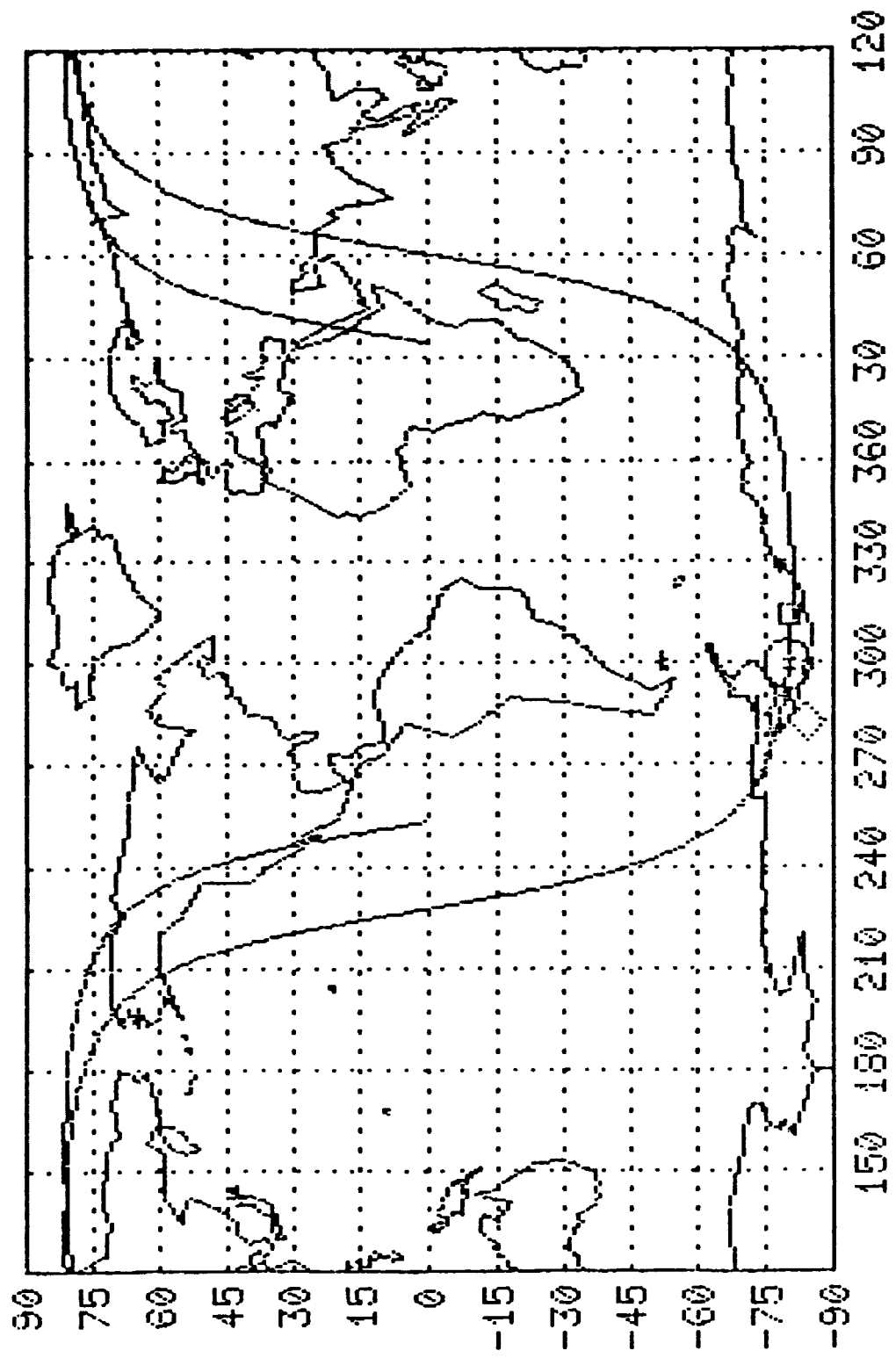
- COMMENTS:**
- Delta 2nd stage rocket.
 - Orbit data derived from element set #569 for satellite 10704.
 - General shape was cylinder plus annulus; length 6.4 m; dia. 1.52 and 2.44 m; weight 350 kg?

CAUSE: Hypergolic fuel ignition due to ruptured tank bulkhead most probable cause.

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LANDSAT-3 R/B

1978-83

COSMOS 1030

11015

LAUNCH DATE: 6.13 Sep 1978

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 10 Oct 1978 (DAY 283)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 4

PIECES STILL IN ORBIT (1 JAN 84): 3

ORBIT CHARACTERISTICS:

INCLINATION: 62.84°

APOGEE: 39760 km

PERIGEE: 666 km

PERIOD: 719.2 min

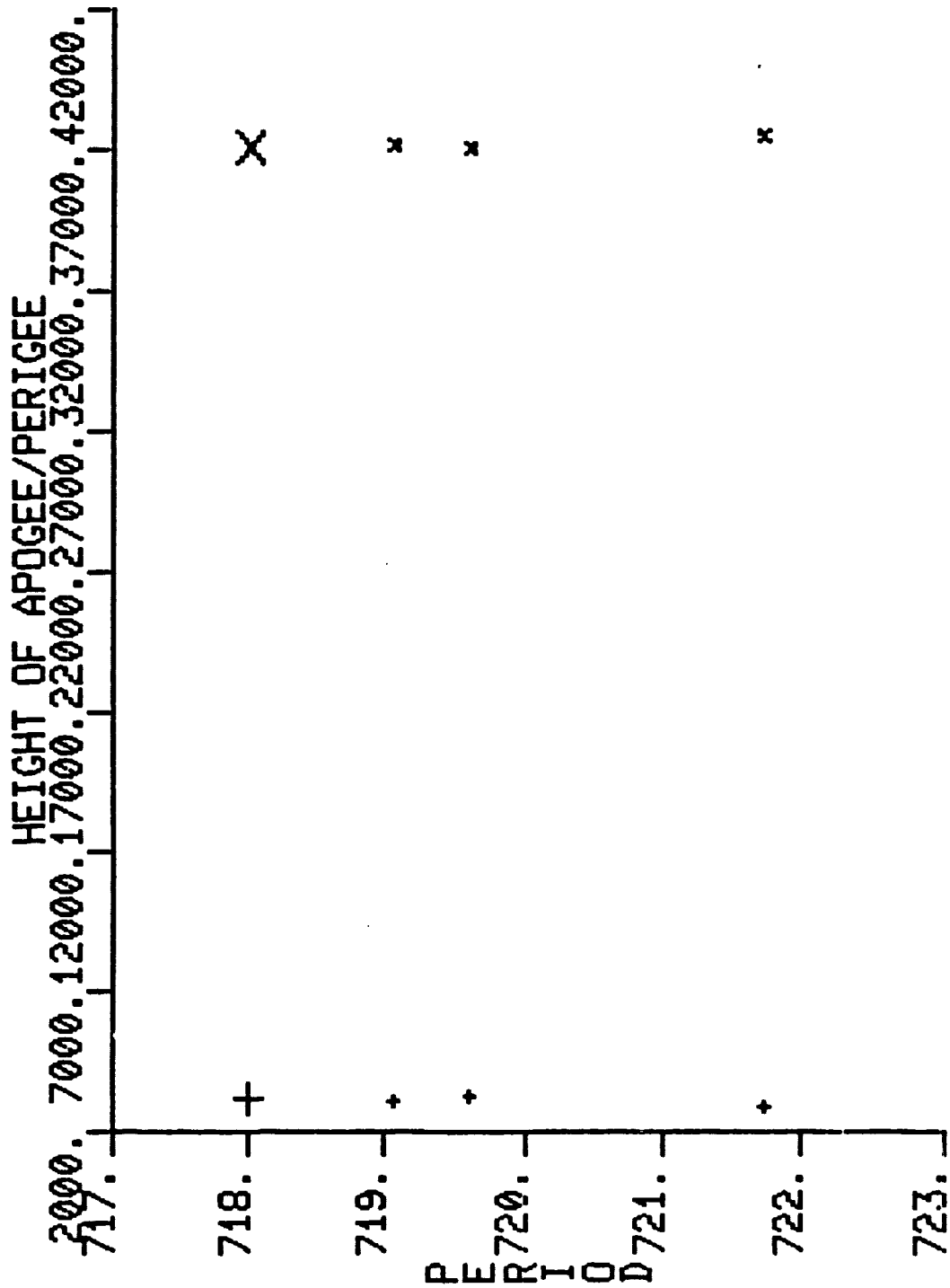
TRUE ANOMALY:

- COMMENTS:**
- General shape was windmill plus 6 vanes?; length 4.2 m; dia. 1.6 m?; weight 1250 kg?
 - Orbit data derived from element set #8 for satellite 11015.
 - Insufficient data available to determine time and location for the satellite 11015 event.

CAUSE: Unknown.

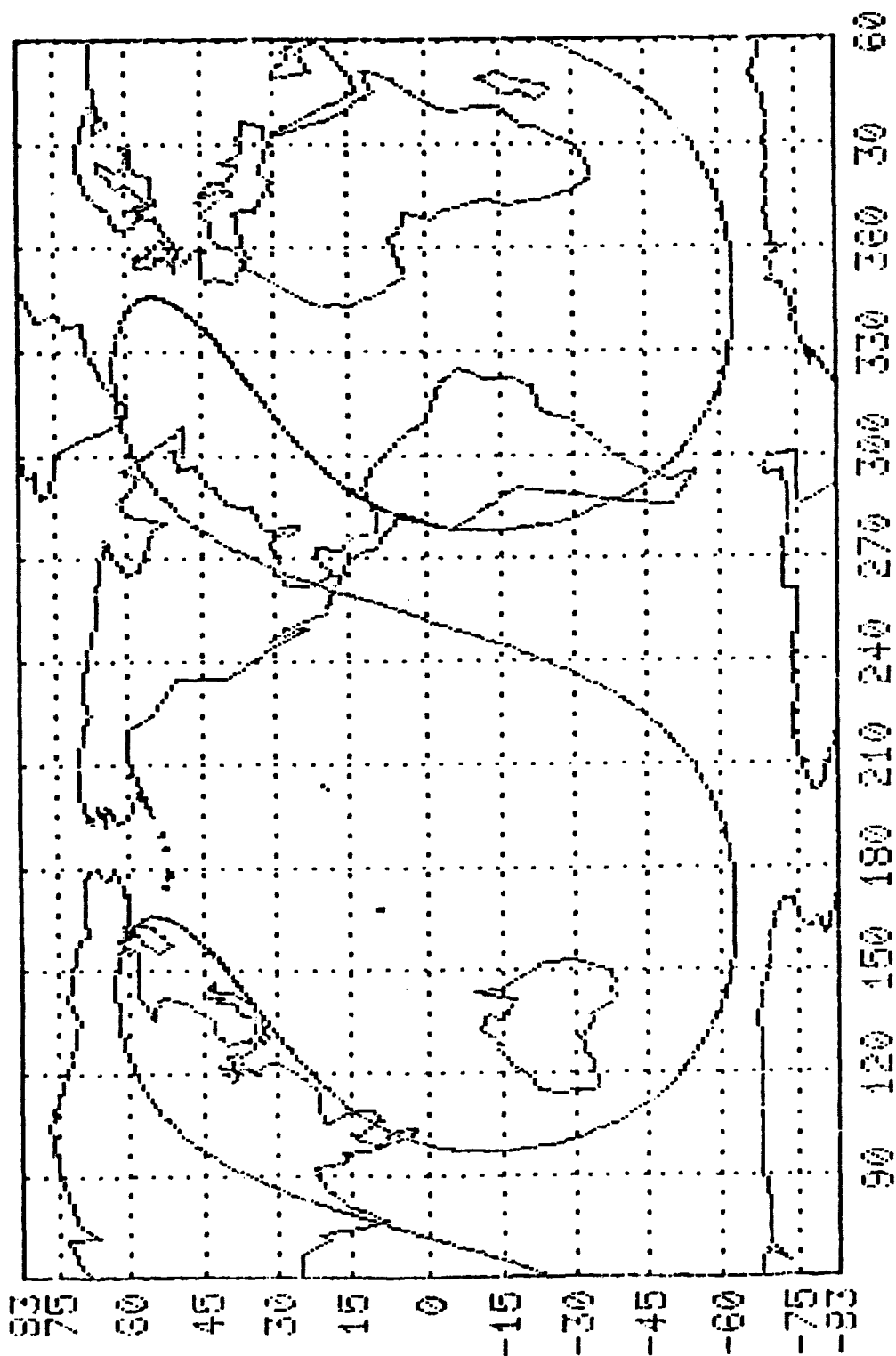
1978-83

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COSMOS 1030

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COSMOS 1030

1979-33

COSMOS 1094

11333

LAUNCH DATE: 18.50 Apr 1979

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 17 Sep 1979 (DAY 260)

TIME: 103906.0 GMT

LOCATION: 54 S/336 E

ALTITUDE: 403 km

PIECES CATALOGED (1 JAN 84): 2

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 65.03°

APOGEE: 405 km

PERIGEE: 382 km

PERIOD: 92.4 min

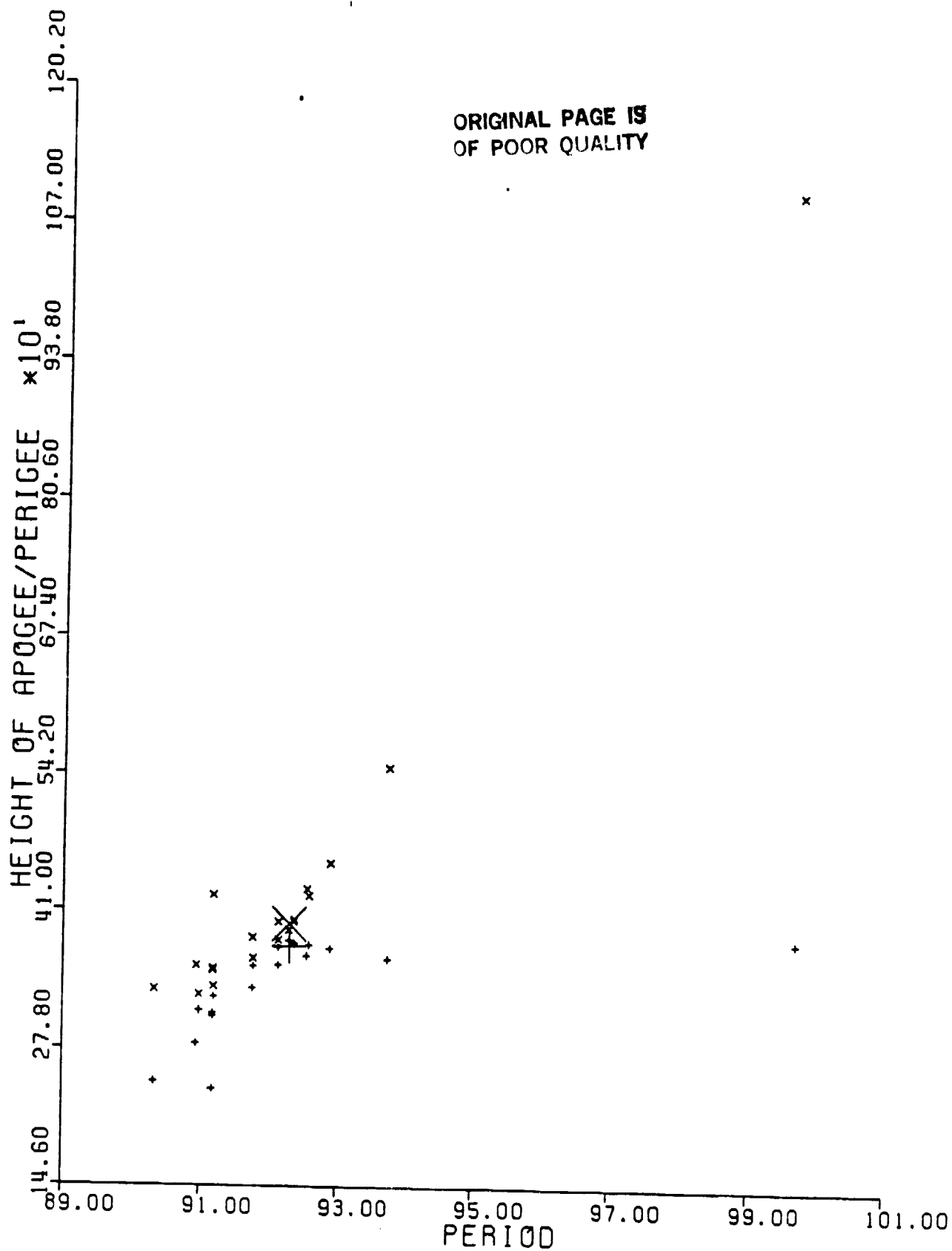
TRUE ANOMALY: 206°

COMMENTS: • 23 known pieces decayed before they could be cataloged but provisional (8X,XXX) elements were developed.

- Member of Cosmos 699 class.

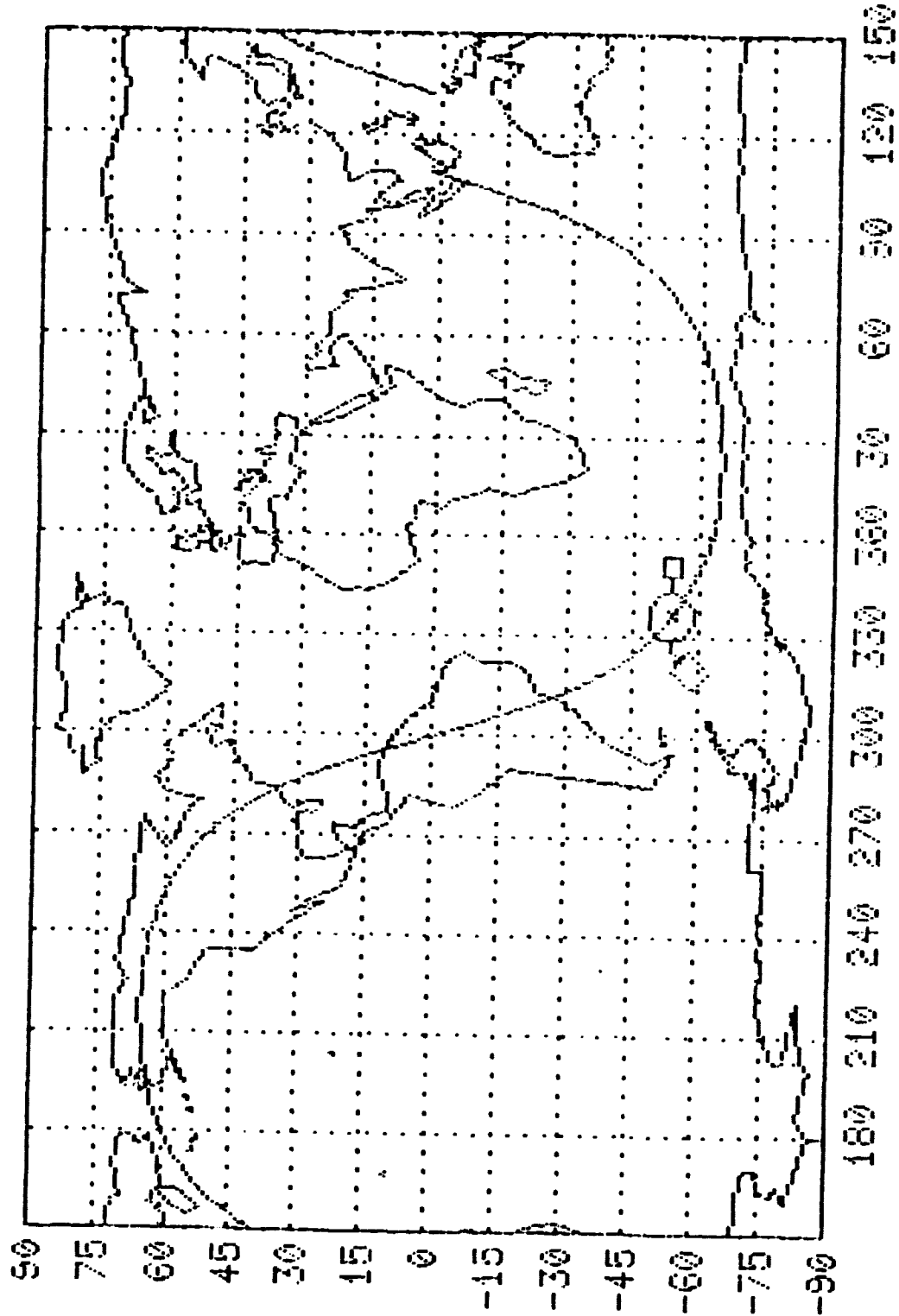
CAUSE: Apparently deliberate fragmentation.

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COSMOS 1094

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COSMOS 1094

1979-58

COSMOS 1109

11417

LAUNCH DATE: 27.76 Jun 1979

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: Late Sep 1979

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 4

PIECES STILL IN ORBIT (1 JAN 84): 4

ORBIT CHARACTERISTICS:

INCLINATION: 62.86°

APOGEE: 39679 km

PERIGEE: 712 km

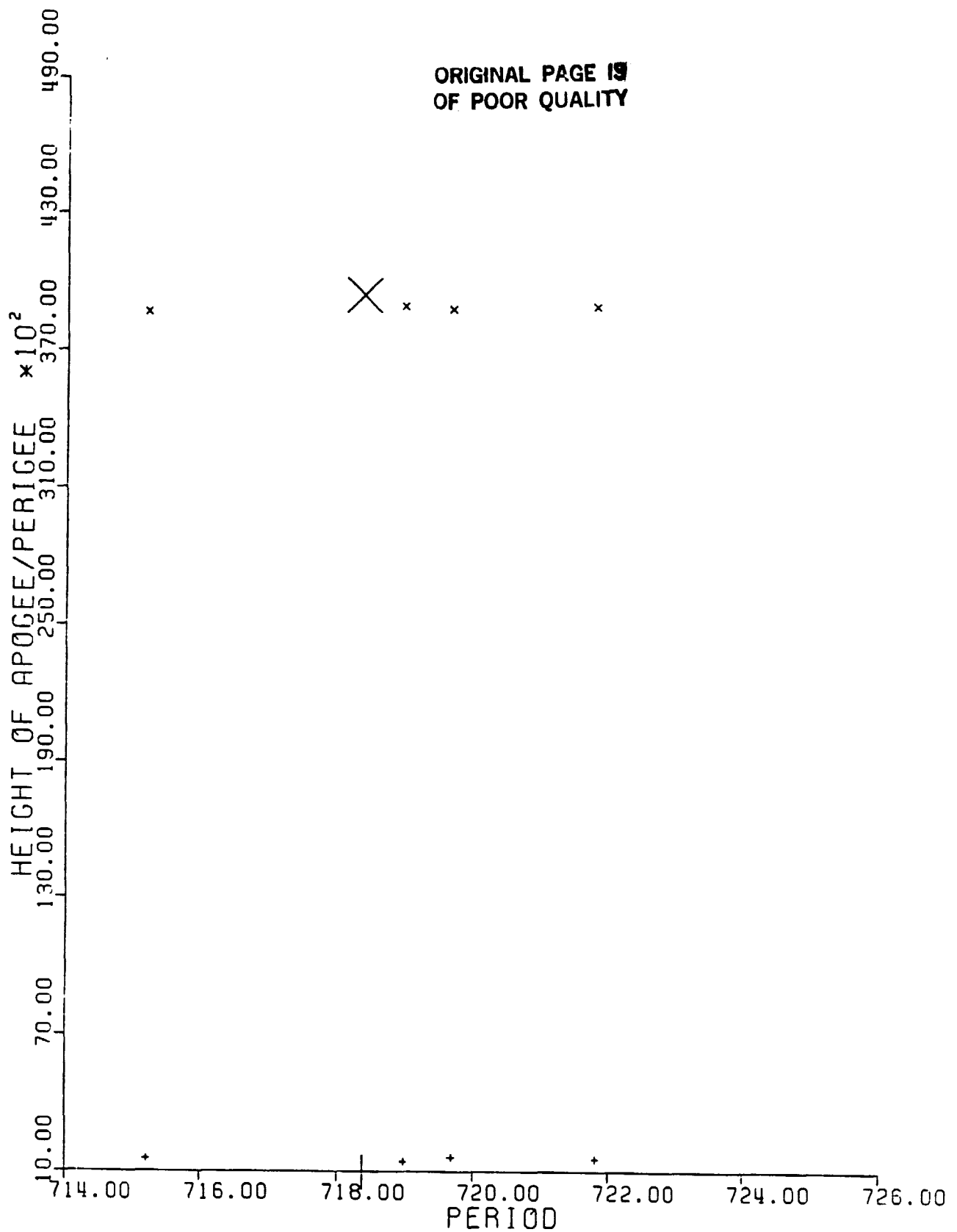
PERIOD: 718.5 min

TRUE ANOMALY:

- COMMENTS:**
- General shape was windmill plus 6 vanes?; length 4.2 m; dia. 1.6?; weight 1250 kg?
 - Orbit data derived from element set #7 for satellite 11417.
 - Insufficient data available to determine time and location for the satellite 11417 event.

CAUSE: Unknown.

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COSMOS 1109

COMMENTS • Insufficient data was available to obtain a ground trace for
1979-58, COSMOS 1109.

1979-77

COSMOS 1124

11509

LAUNCH DATE: 28.01 Aug 1979

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 9 Sep 1979 (DAY 252)

TIME: 022932.4 GMT

LOCATION: 52 N/304 E

ALTITUDE: 8100 km

PIECES CATALOGED (1 JAN 84): 5

PIECES STILL IN ORBIT (1 JAN 84): 5

ORBIT CHARACTERISTICS:

INCLINATION: 62.93°

APOGEE: 39754 km

PERIGEE: 574 km

PERIOD: 717.2 min

TRUE ANOMALY: 103°

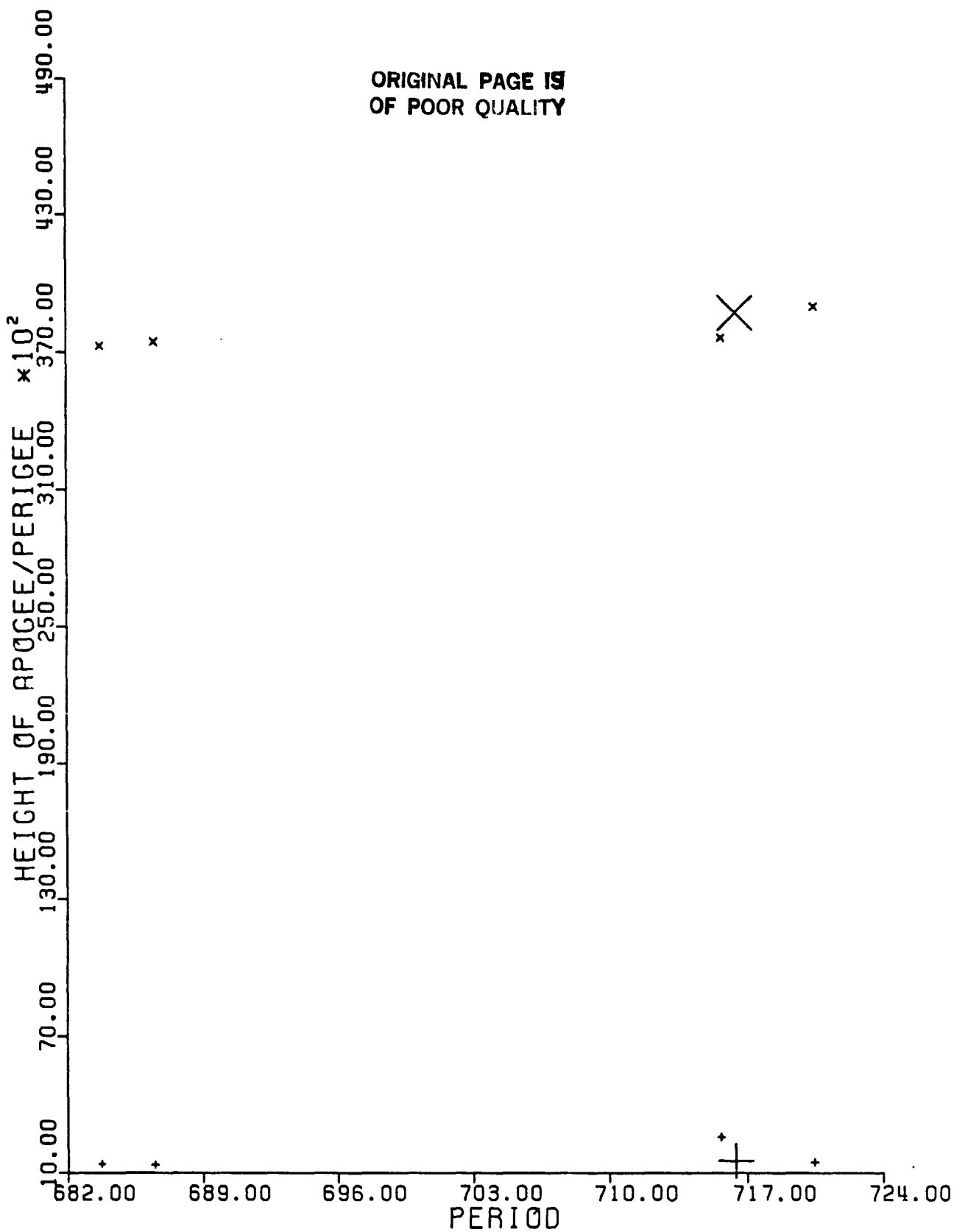
COMMENTS: • General shape was windmill plus 6 vanes?; length 4.2 m; dia. 1.6 m?; weight 1250 kg?

• Orbit data derived from element set with epoch 79249.09583699 for satellite 11509.

CAUSE: Unknown.

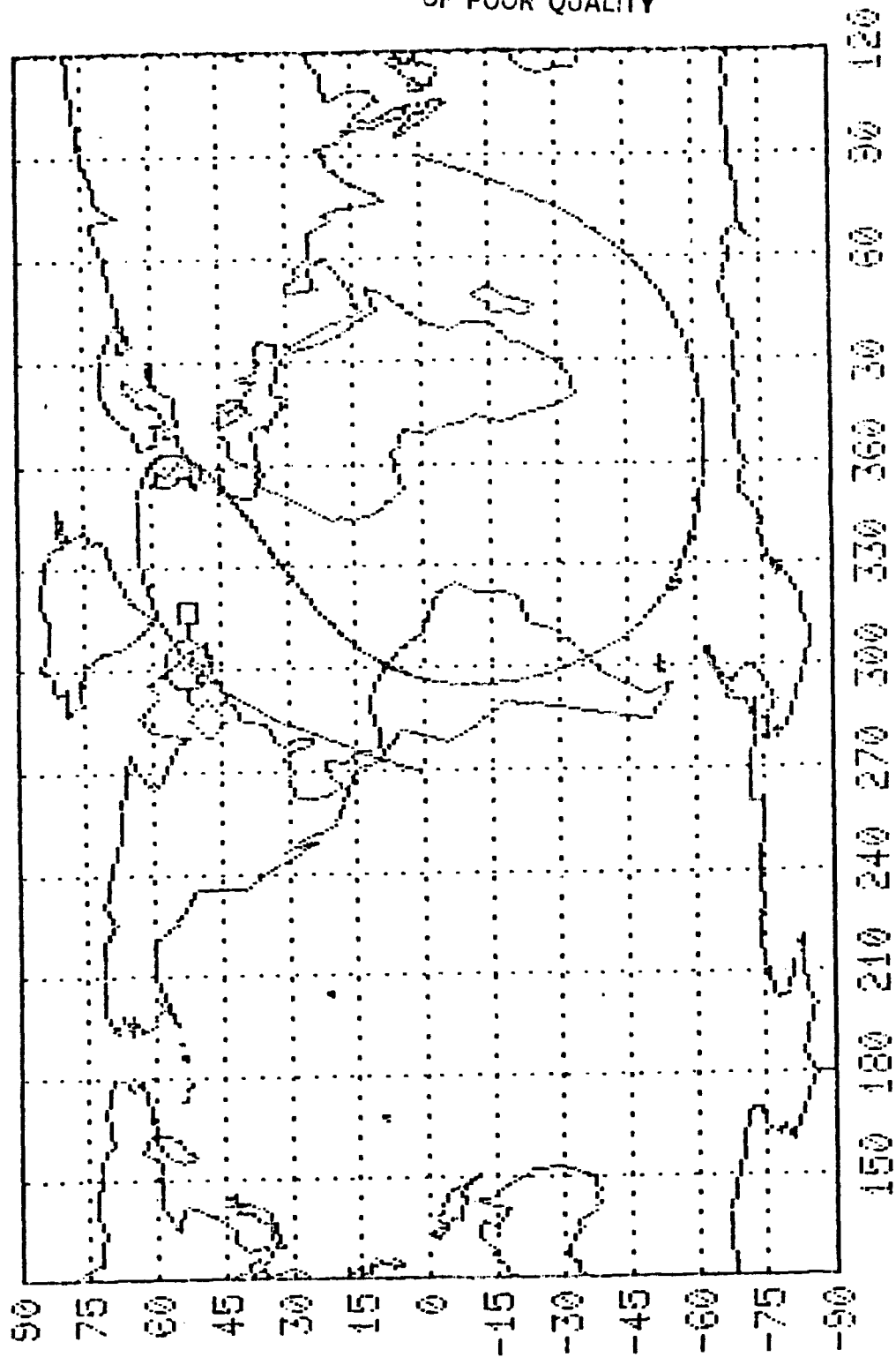
1979-77

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COSMOS 1124

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COSMOS 1124

1979-104

ARIANE V1

11659

LAUNCH DATE: 24.72 Dec 1979

COUNTRY OF ORIGIN: France

EVENT DATA:

DATE: Early 1980

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 1

PIECES STILL IN ORBIT (1 JAN 84): Est. at least 25

ORBIT CHARACTERISTICS:

INCLINATION: 17.6°

APOGEE: 35839 km

PERIGEE: 189 km

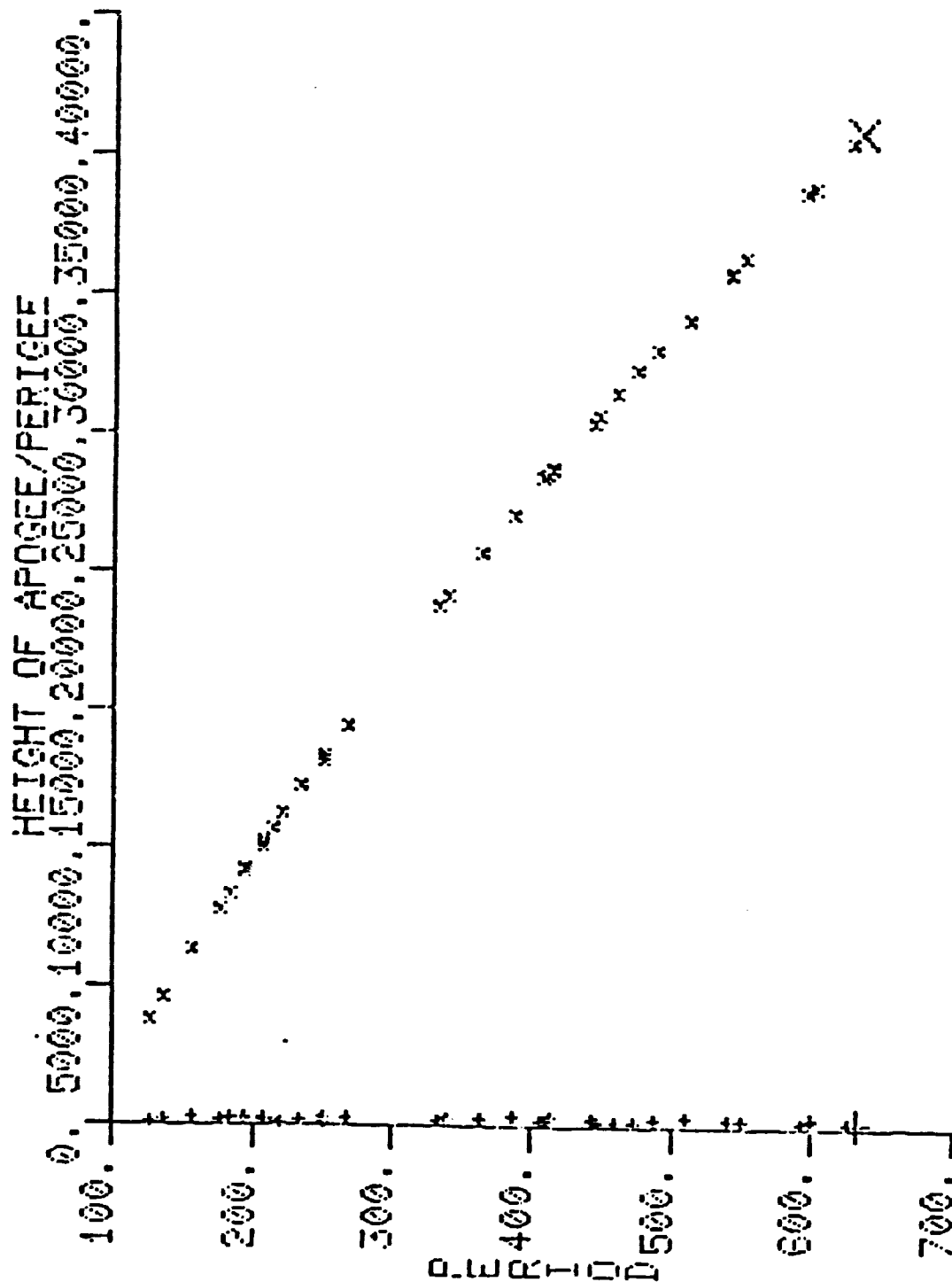
PERIOD: 631.9 min

TRUE ANOMALY:

- COMMENTS:**
- This event was discovered by analysis of the provisional (8X,XXX) elements in the NORAD catalog.
 - Only the payload and rocket of this launch have been cataloged. Due to inconsistent observation of the smaller low inclination, (17°) fragments they become alternately lost then found as the observable portion of the orbits moved within and then out of sensor coverages.
 - At any given time from 7 to 12 provisional elements are resident in the catalog.
 - General shape was a sphere; dia. unk; weight 217 kg capsule plus 1385 kg ballast.
 - Insufficient data available to determine the time and location for the satellite 11659 event.
 - Orbit data for satellite 11659 derived from element set #1.
 - Millstone radar team believes third stage blew-up approximately 90 days after launch.

CAUSE: Unknown.

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COMMENTS • Insufficient data available to show applicable ground track for satellite 11659.

1979-104

1980-21

COSMOS 1167

11729

LAUNCH DATE: 14.45 Mar 1980

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 15 Jul 1981 (DAY 196)

TIME: 092049.7 GMT

LOCATION: 10 N/106 E

ALTITUDE: 437 km

PIECES CATALOGED (1 JAN 84): 12

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 65.31°

APOGEE: 450 km

PERIGEE: 357 km

PERIOD: 92.6 min

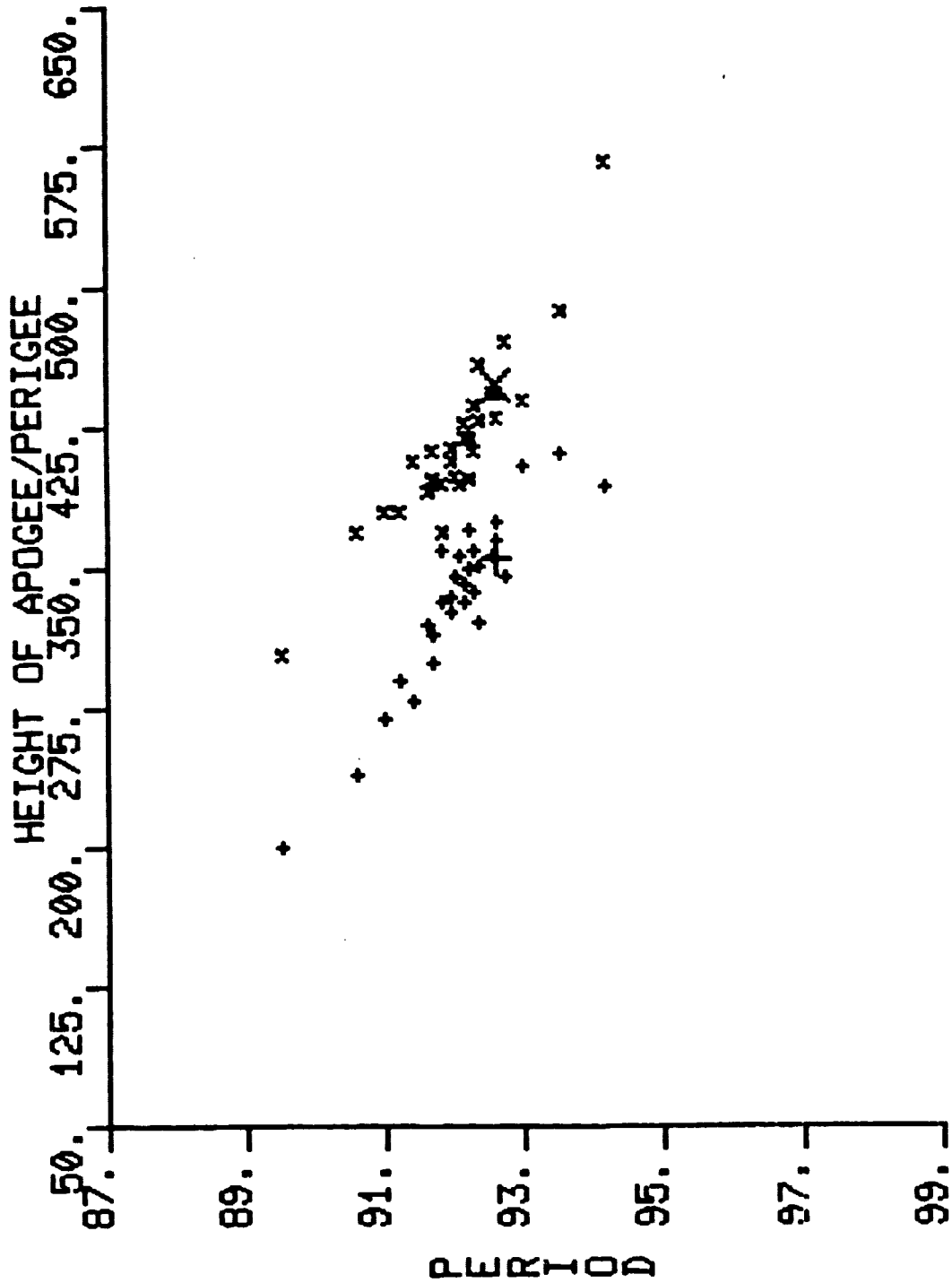
TRUE ANOMALY: 222°

COMMENTS: • Orbit derived from element set #573 for satellite 11729.

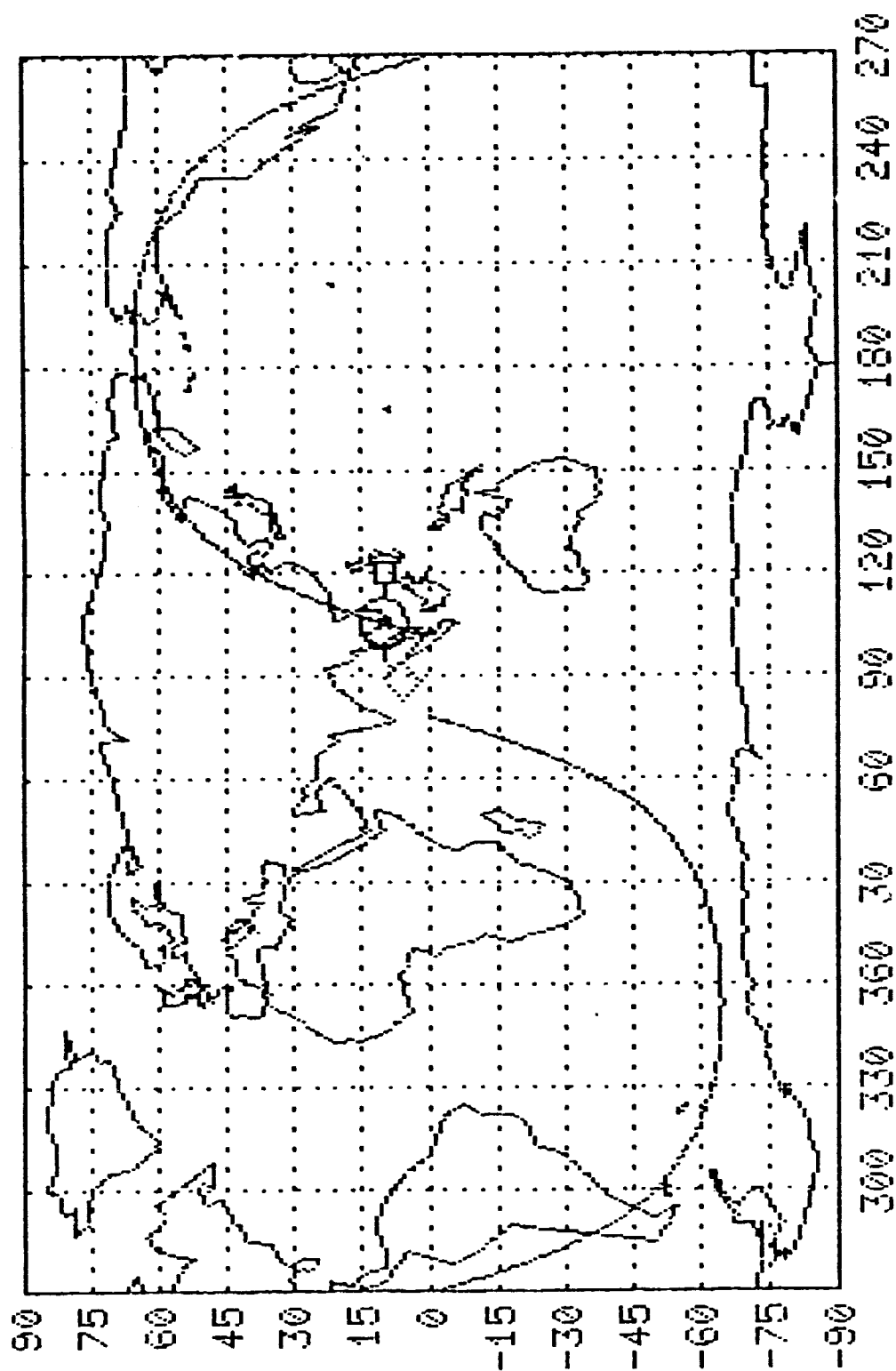
• Member of Cosmos 699 class.

CAUSE: Apparently deliberate fragmentation.

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COSMOS 1167



COSMOS 1167

1980-30

COSMOS 1174

11765

LAUNCH DATE: 18.04 Apr 1980

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 18 Apr 1980 (DAY 109)

TIME: 072616.1 GMT

LOCATION: 47 N/322 E

ALTITUDE: 986 km

PIECES CATALOGED (1 JAN 84): 39

PIECES STILL IN ORBIT (1 JAN 84): 22

ORBIT CHARACTERISTICS:

INCLINATION: 65.84°

APOGEE: 1025 km

PERIGEE: 362 km

PERIOD: 98.6 min

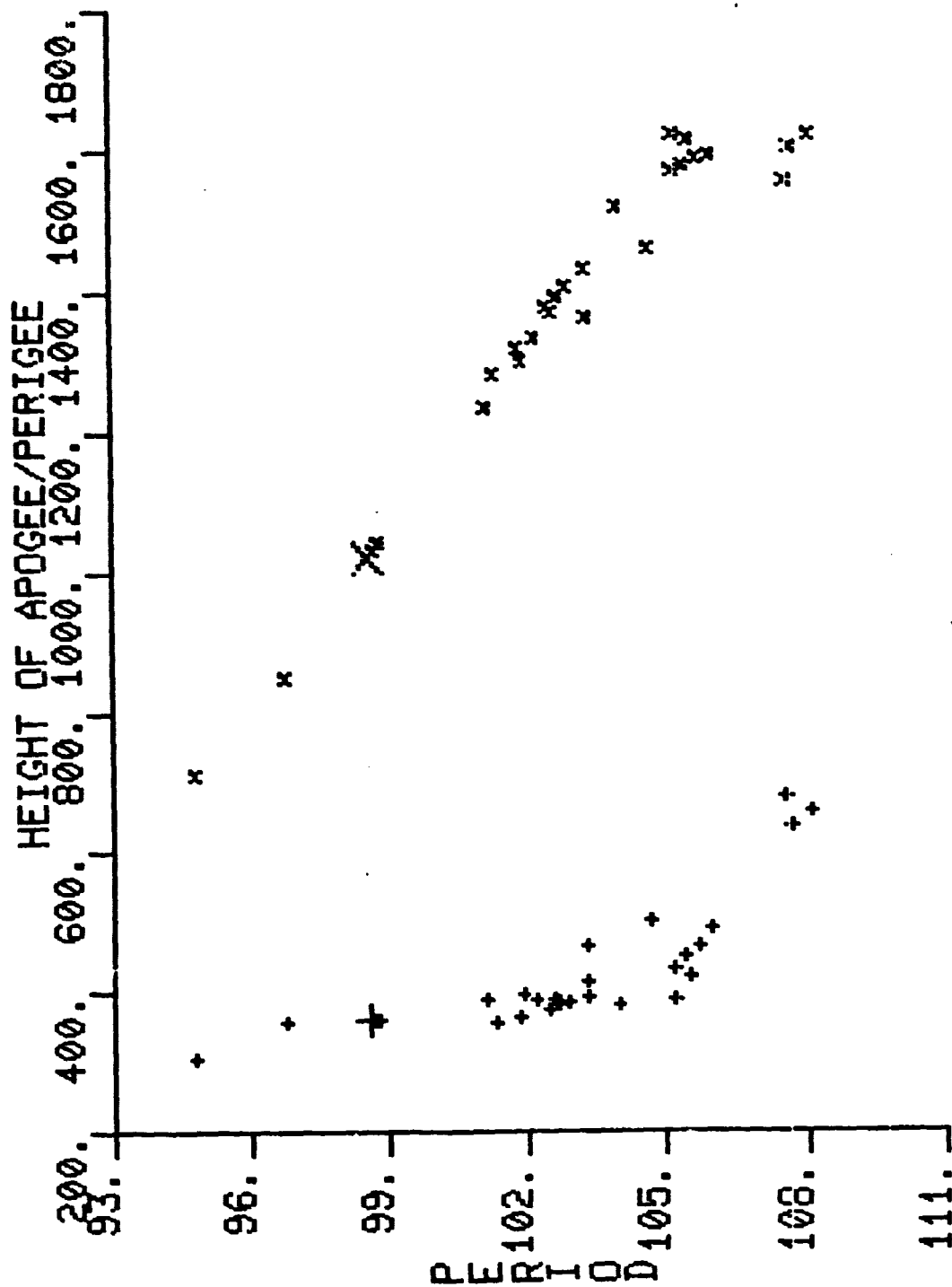
TRUE ANOMALY: 154°

COMMENTS:

- Alleged Soviet ASAT test.
- Orbit data derived from element set #2 for satellite 11765.
- General shape; cylinder?

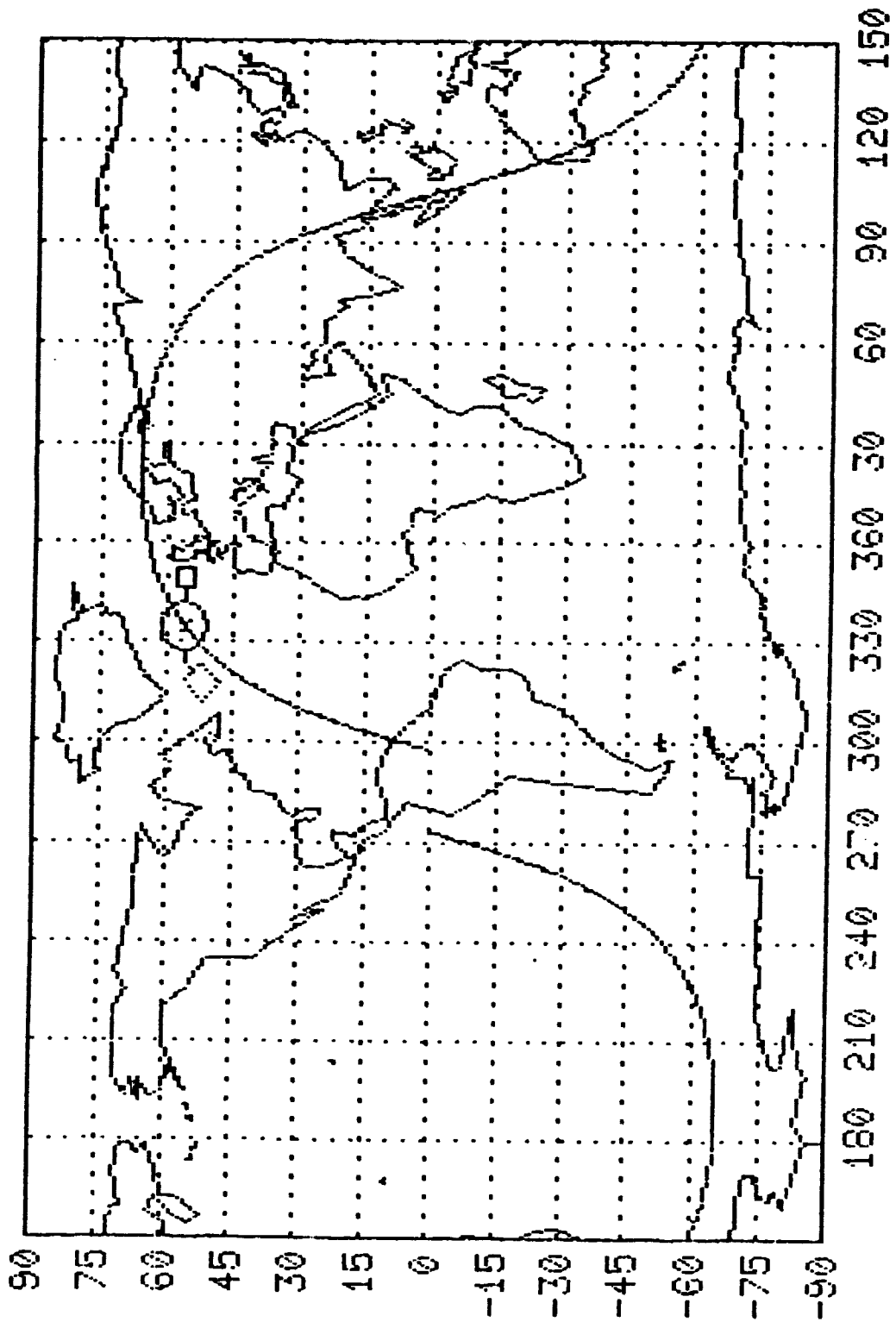
CAUSE: Fragmentation due to alleged ASAT test.

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COSMOS 1174

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COSMOS 1174

1980-57

COSMOS 1191

11871

LAUNCH DATE: 2.04 Jul 1980

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 14 May 1981 (DAY 134)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 2

PIECES STILL IN ORBIT (1 JAN 84): 2

ORBIT CHARACTERISTICS:

INCLINATION: 62.64°

APOGEE: 39283 km

PERIGEE: 1083 km

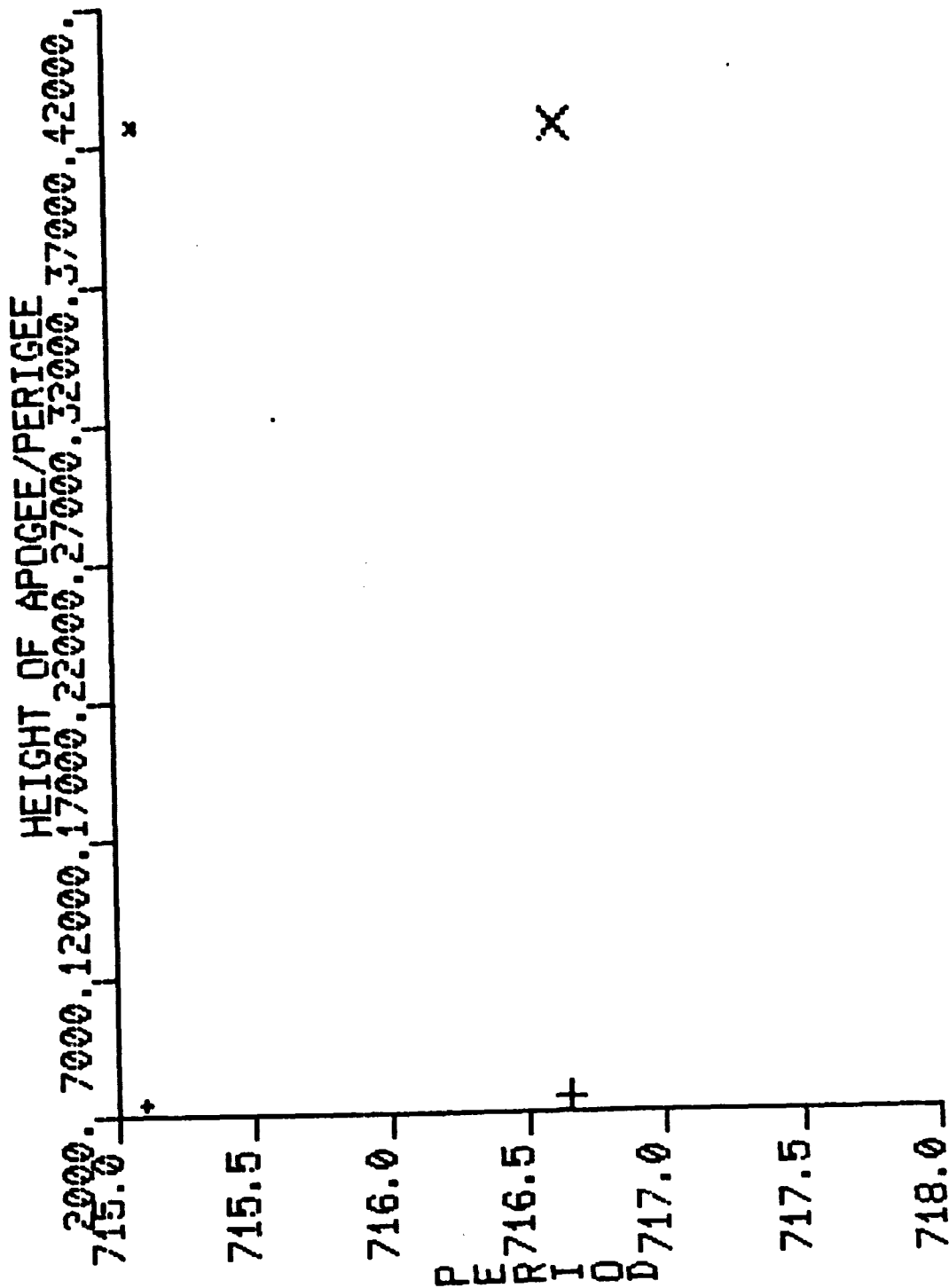
PERIOD: 718.0 min

TRUE ANOMALY:

- COMMENTS:**
- This event uncovered after the fact by analysis of provisional (8X,XXX) elements being actively carried in the NORAD system.
 - The event date was determined by examination of the mean motion for satellite 11871 over a period of 2 years and correlating a significant change with the appearance of the provisional element sets.
 - Six 8X,XXX elements were in the system but only one was cataloged.
 - Orbit data derived from an element set with 14 March 1981 epoch for satellite 11871.
 - General shape was windmill plus 6 vanes?; length 4.2m?; dia. 1.6 m; weight 1250 kg?
 - Insufficient data available to determine time and location of the event for satellite 11871.

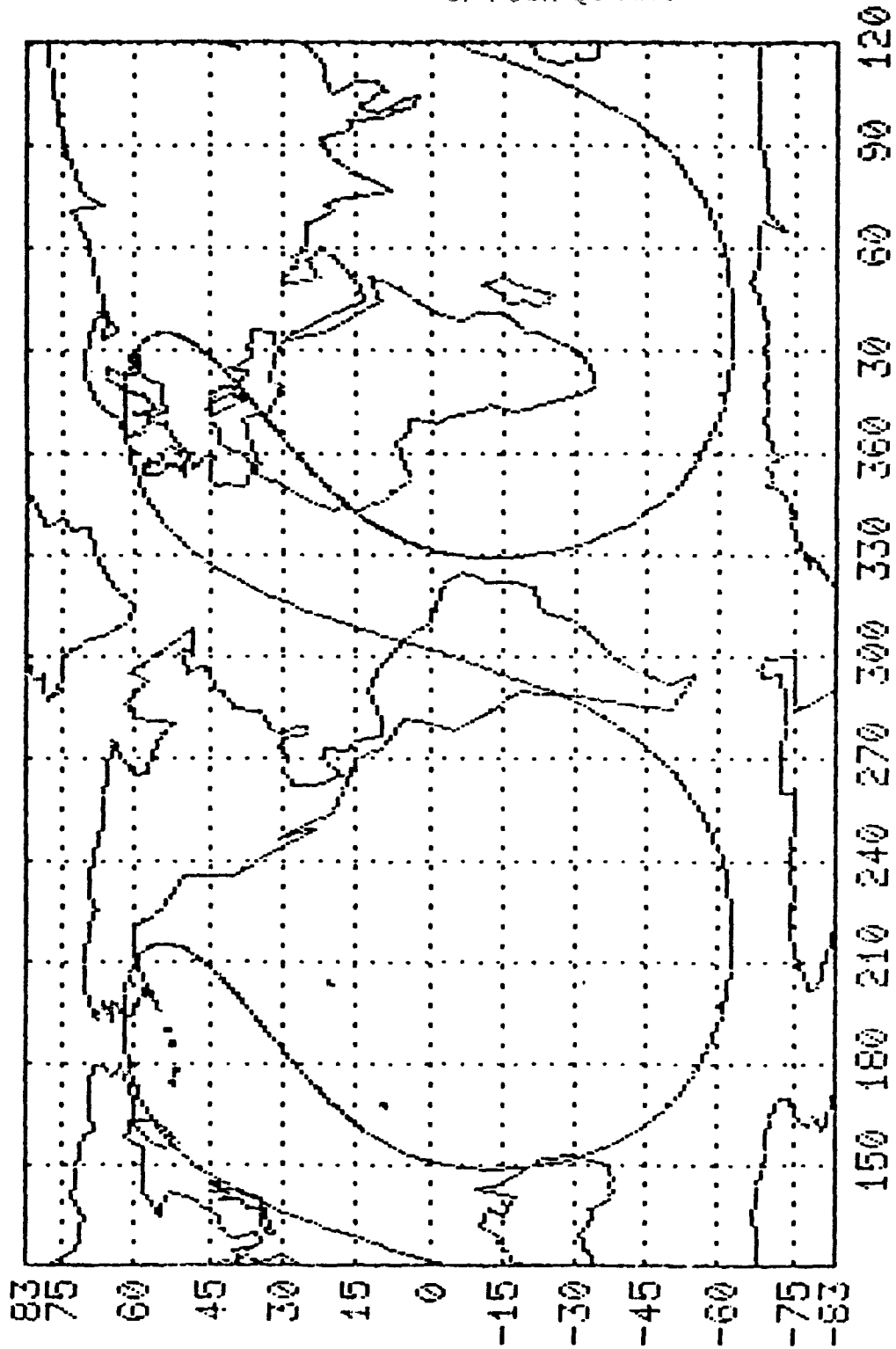
CAUSE: Unknown.

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COSMOS 1191

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COSMOS 1191

1980-89

COSMOS 1220

12054

LAUNCH DATE: 4.63 Nov 1980

COUNTRY OF ORIGIN: USSR

EVENT DATA:

1.

2.

DATE: 20 Jun 1982 (DAY 171)

25 Aug 1982 (DAY 237)

TIME: 181814.2 GMT

123121.6 GMT

LOCATION: 10 S/332 E

65 S/238 E

ALTITUDE: 877 km

666 km

PIECES CATALOGED (1 JAN 84): 63

PIECES STILL IN ORBIT (1 JAN 84): 57

ORBIT CHARACTERISTICS:

INCLINATION: 65.00°

65.00°

APOGEE: 883 km

873 km

PERIGEE: 571 km

580 km

PERIOD: 99.3 min

99.3 min

TRUE ANOMALY: 195°

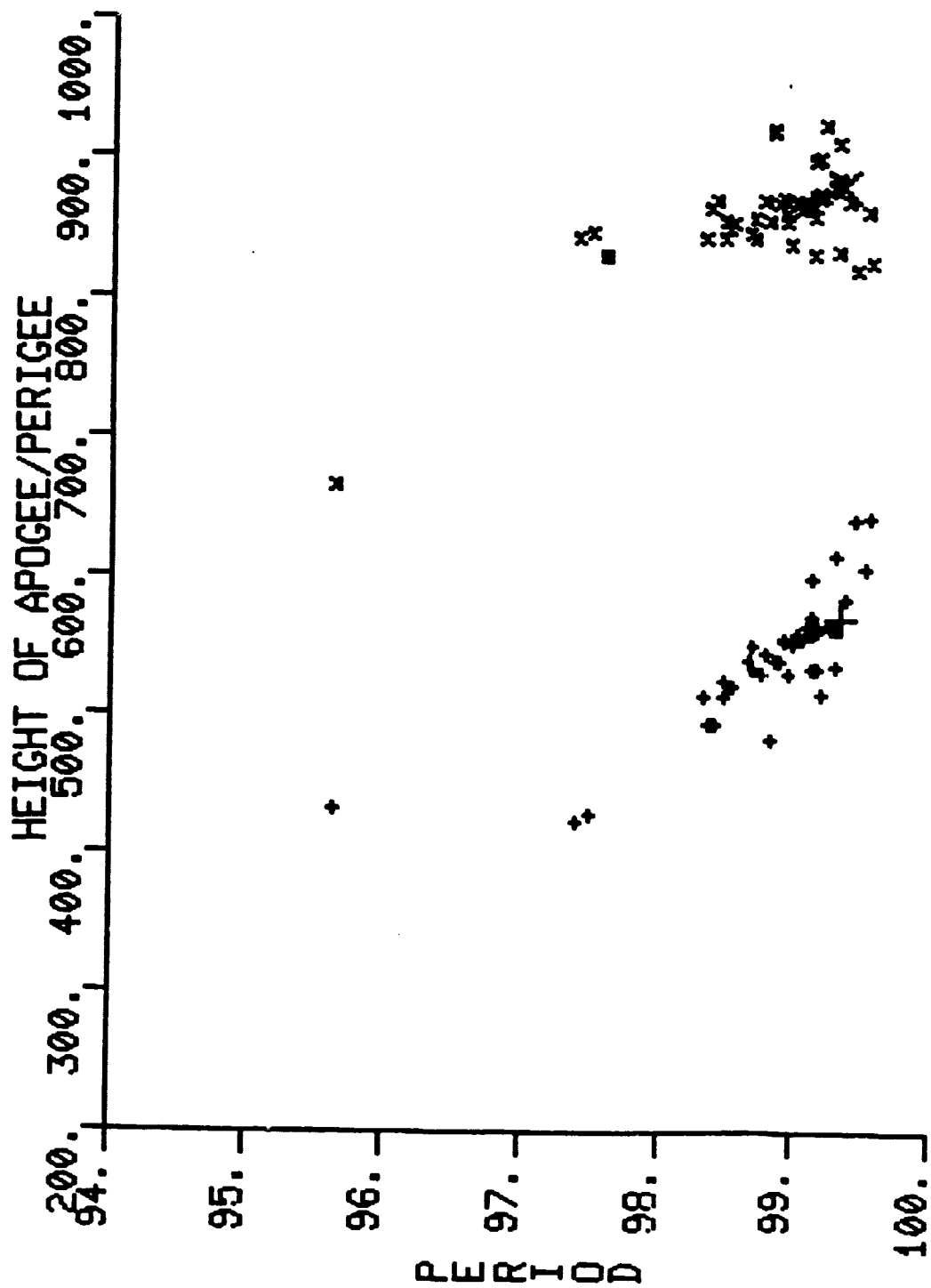
293°

COMMENTS:

- Orbit data derived from element set #656 for satellite 12054.
- Eleven of the 63 pieces cataloged were cataloged after the 2nd event.
- Member of Cosmos 699 class.

CAUSE: Apparently deliberate fragmentations.

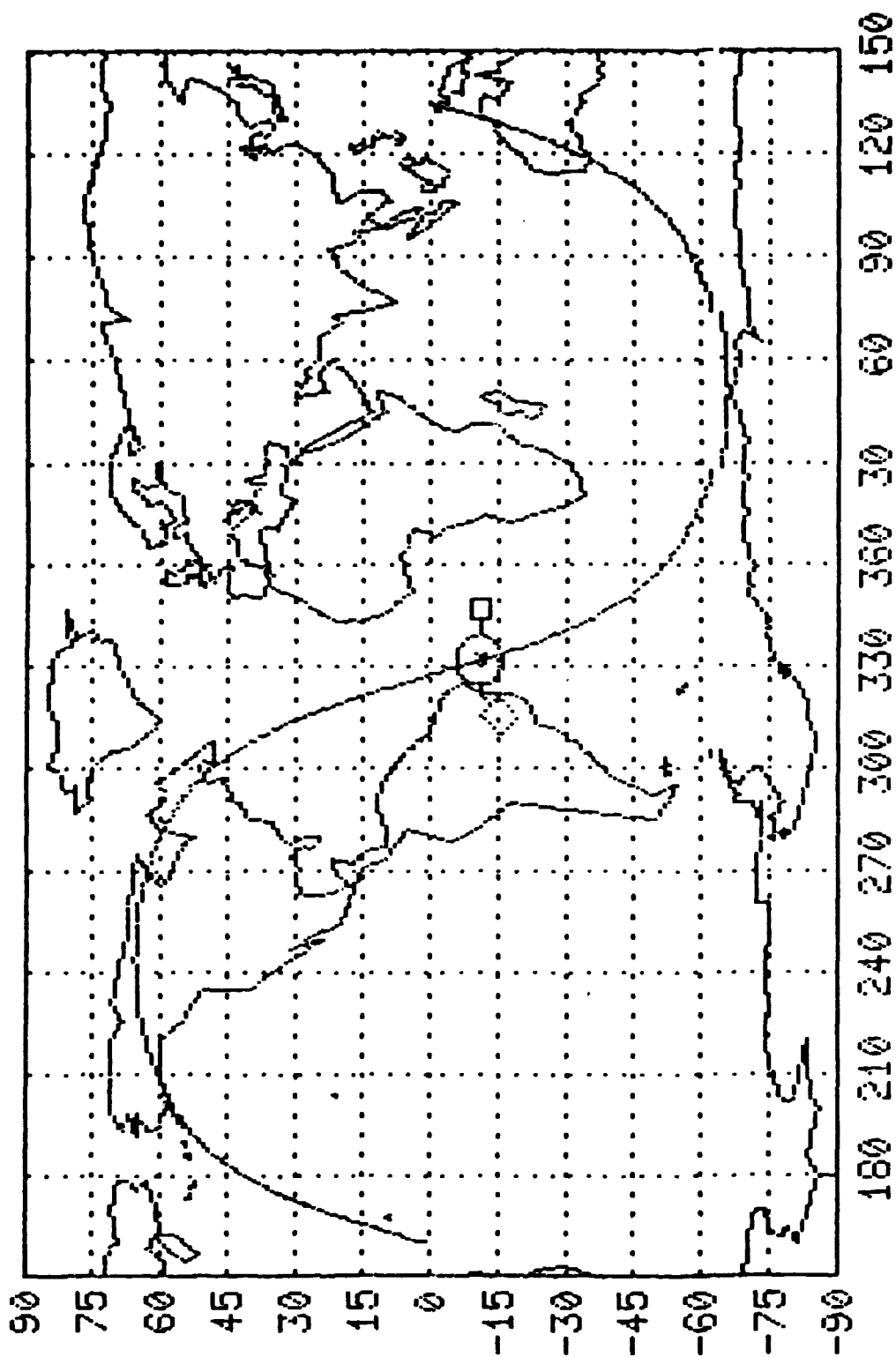
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COSMOS 1220

(EVENT 1)

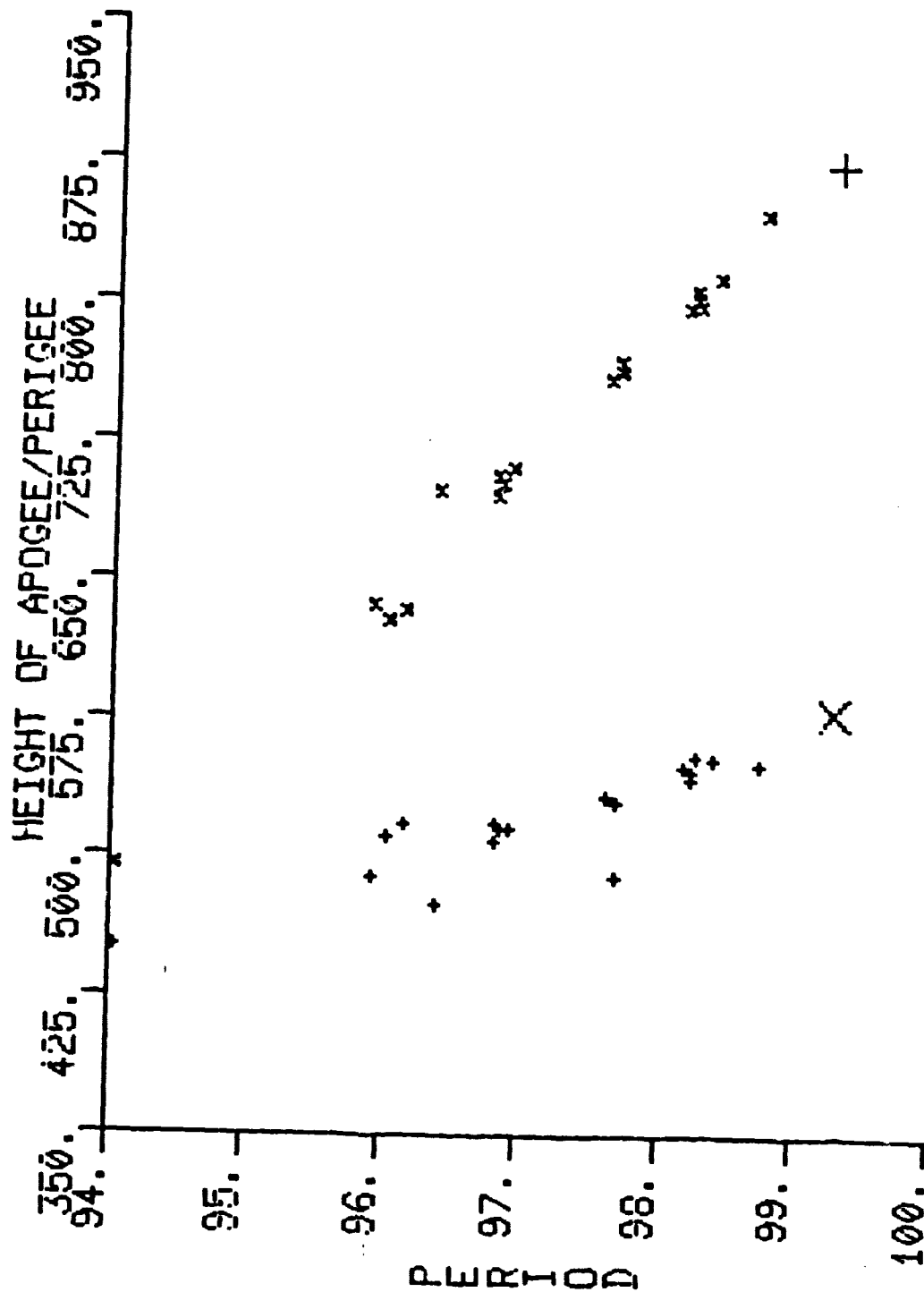
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COSMOS 1220

(EVENT 1)

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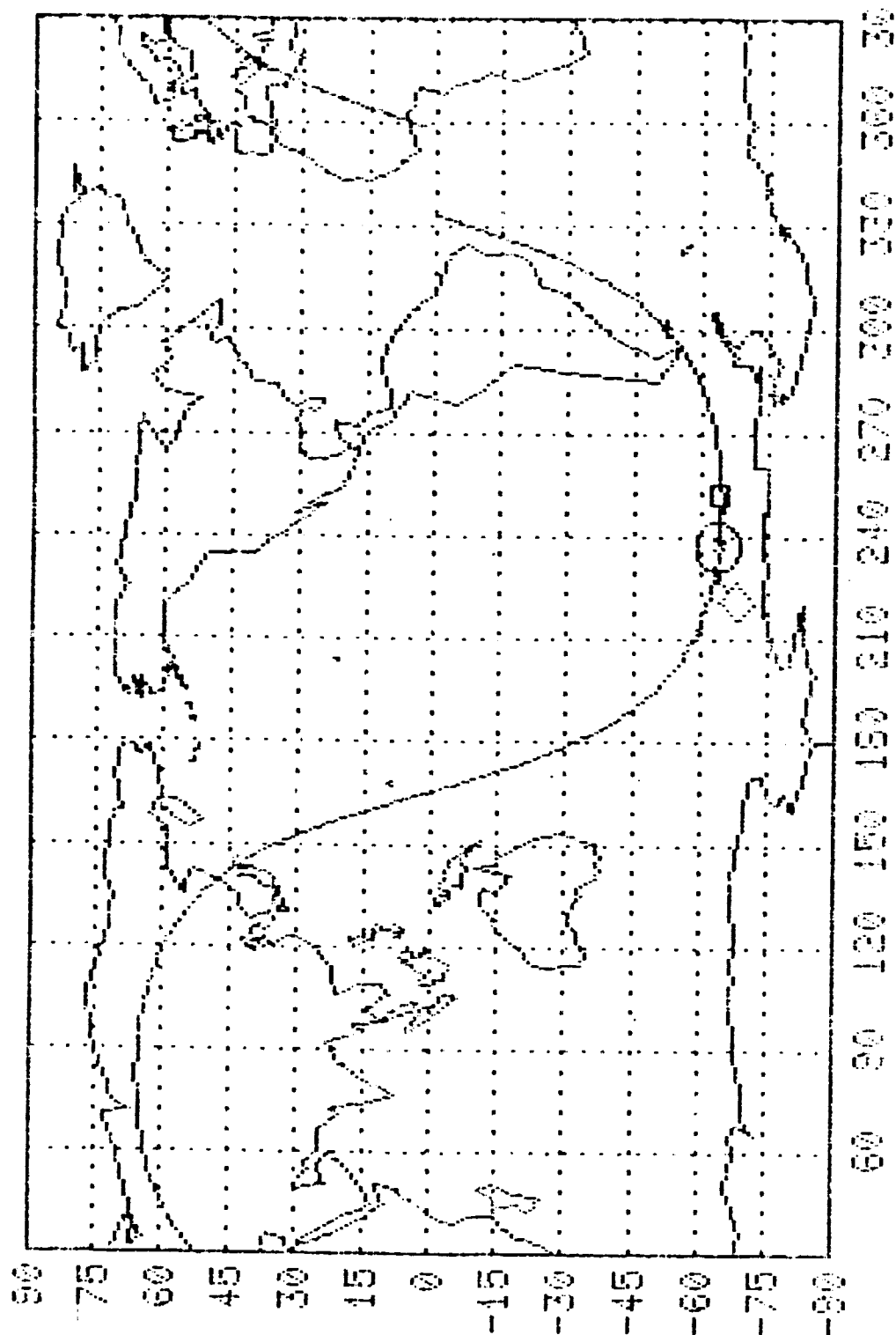


COSMOS 1220

(EVENT 2)

1-252

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COSMOS 1220

(EVENT 2)

1981-16

COSMOS 1247

12303

LAUNCH DATE: 19.48 Feb 1981

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 20 Oct 1981 (DAY 293)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 4

PIECES STILL IN ORBIT (1 JAN 84): 4

ORBIT CHARACTERISTICS:

INCLINATION: 62.97°

APOGEE: 39401 km

PERIGEE: 362 km

PERIOD: 717.9 min

TRUE ANOMALY:

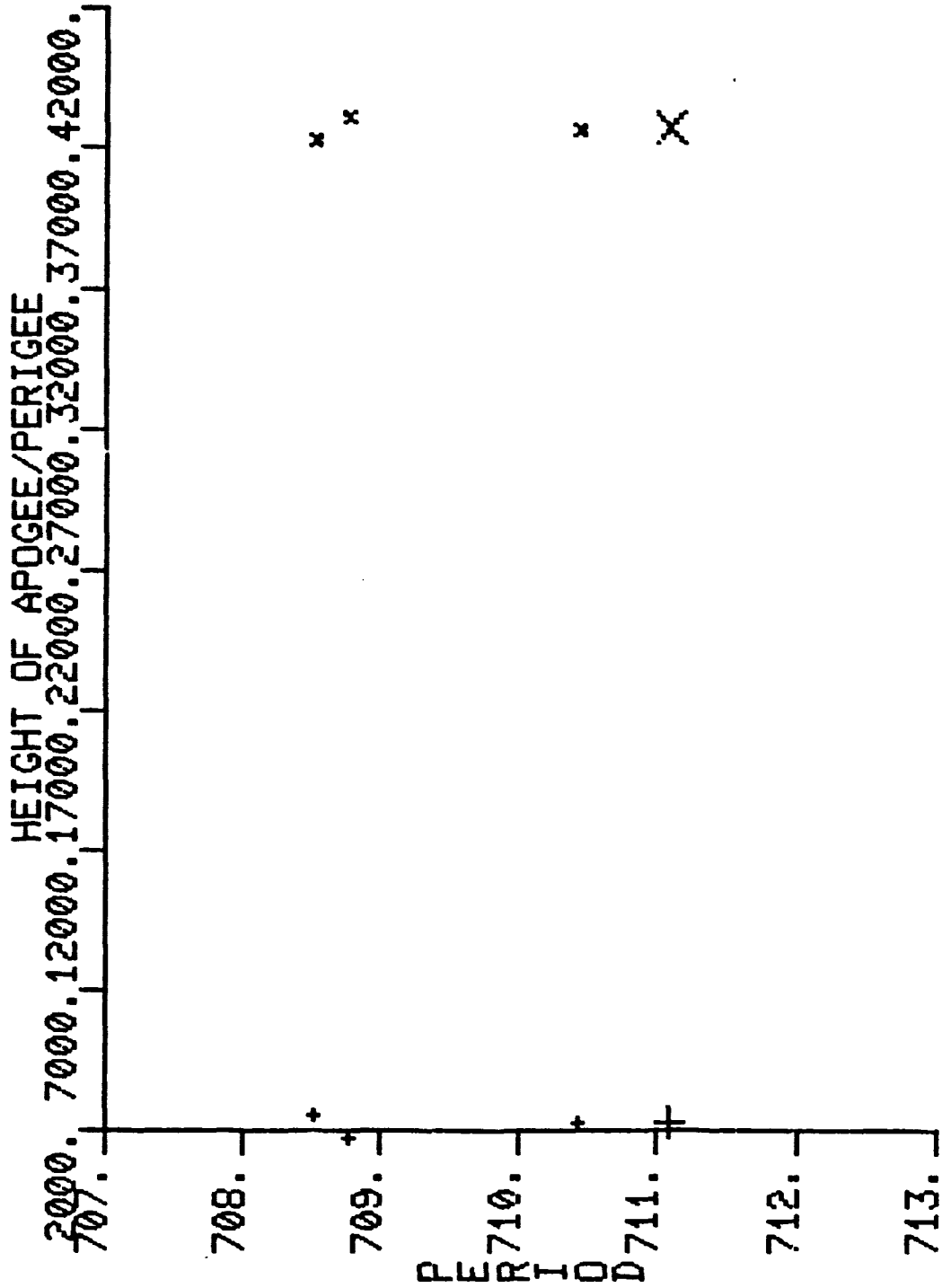
- COMMENTS:**
- General shape was windmill plus 6 vanes?; length 4.2 m?; dia. 1.6 m; weight 1250 kg?
 - Best estimate of event date is mid October 1981 and the orbit data has been derived from a mid October element set #236 for satellite 12303.

CAUSE: Unknown.

1981-16

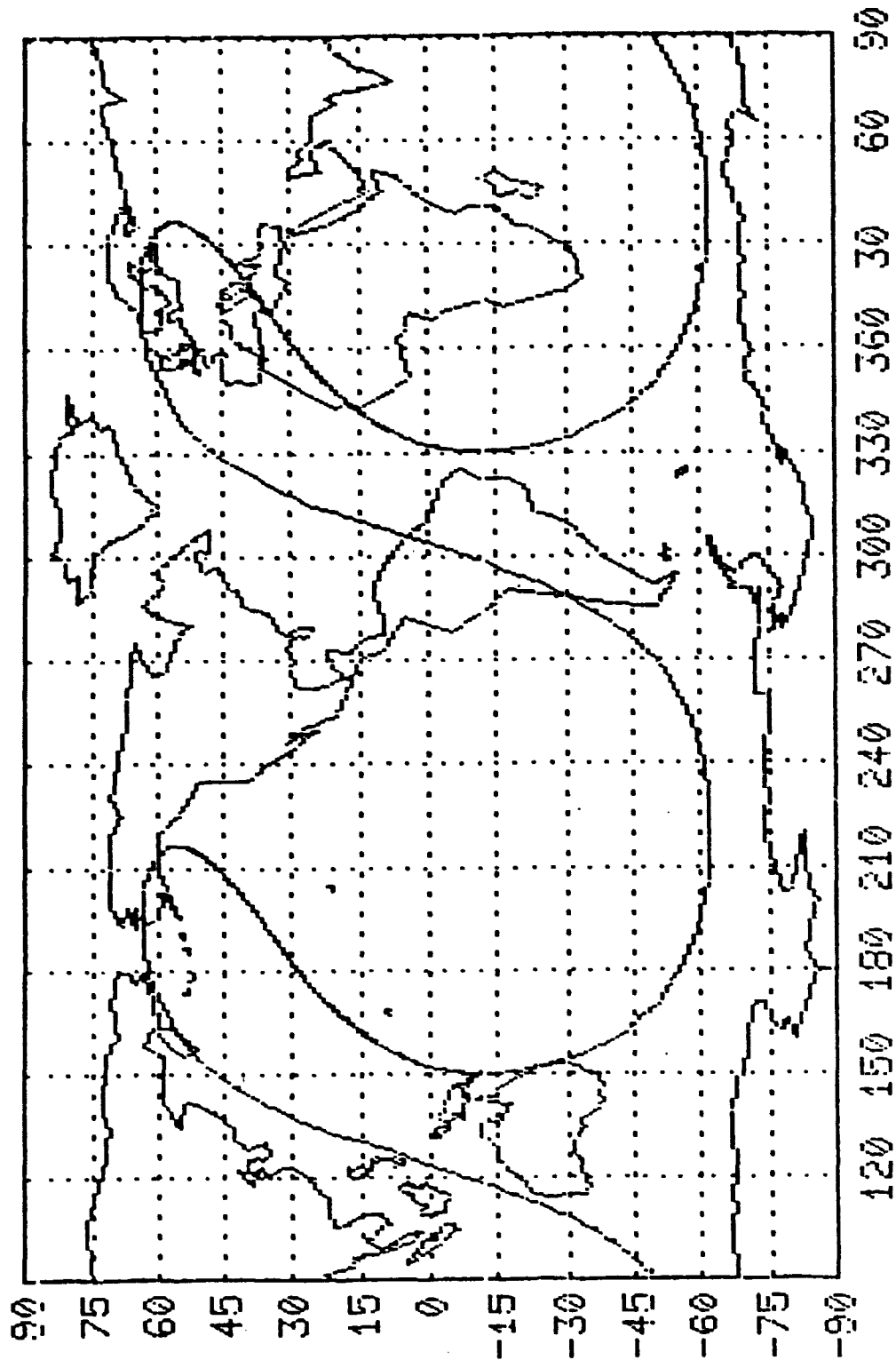
1-255

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COSMOS 1247

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COSMOS 1247

1981-24

COSMOS 1258

12337

LAUNCH DATE: 14.71 Mar 1981

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 14 Mar 1981 (DAY 73)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 1

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 65.8°

APOGEE: 1024 km

PERIGEE: 301 km

PERIOD: 98.0 min

TRUE ANOMALY:

- COMMENTS:**
- Alleged Soviet ASAT test.
 - 12 to 18 pieces detected re-entering. No fragments were cataloged.
 - Insufficient data available to determine time and location of the event for satellite 12337.

CAUSE: Fragmentation due to alleged ASAT test activity.

COMMENTS:

- A graph of the distribution of orbits of the fragments can not be presented because no fragments were cataloged. A simulation of the expected distribution of orbits could not be generated due to the uncertainty of the orbit at time of fragmentation.

1981-24

COMMENTS: • Insufficient data available to show applicable ground trace for satellite 12337.

1981-28

COSMOS 1260

12364

LAUNCH DATE: 21.00 Mar 1981

COUNTRY OF ORIGIN: USSR

EVENT DATA: 1.

2.

DATE: 8 May 1982 (DAY 128)

10 Aug 1982 (DAY 222)

TIME: 044424.3 GMT

233513.4 GMT

LOCATION: 40 N/62 E

51 N/238 E

ALTITUDE: 557 km

752 km

PIECES CATALOGED (1 JAN 84): 65

PIECES STILL IN ORBIT (1 JAN 84): 37 (Event 1 & 2)

ORBIT CHARACTERISTICS:

INCLINATION: 65.02°

65.02°

APOGEE: 720 km

753 km

PERIGEE: 422 km

447 km

PERIOD: 96.1 min

96.7 min

TRUE ANOMALY: 74°

186°

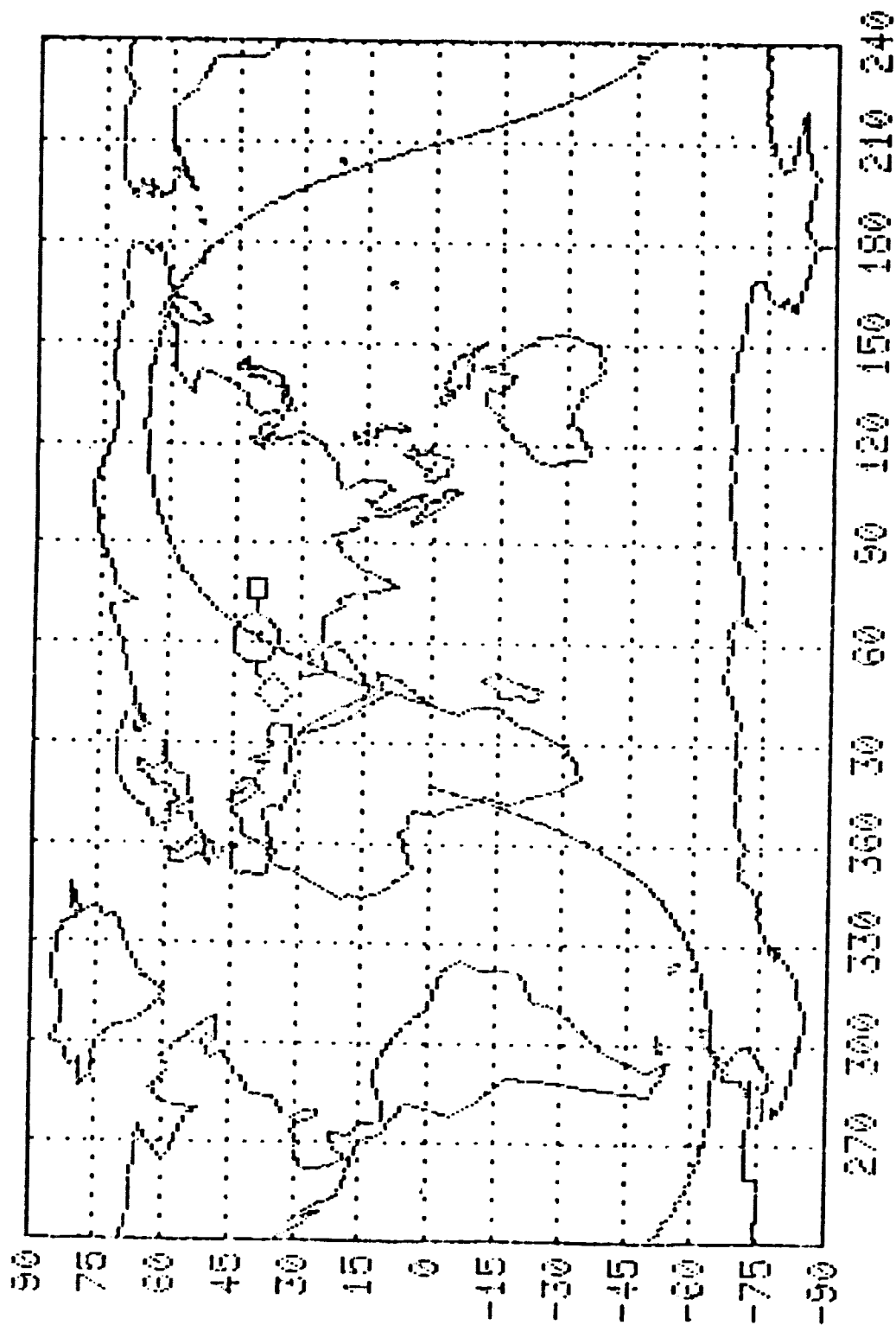
- COMMENTS:**
- Two separate events. The largest piece remaining after the first event was designated satellite 13183. Its orbit was a little higher than the original parent orbit. This piece fragmented on 10 Aug 1982.
 - Orbit data for satellites 12364 and 13183 was derived from element sets #483 and #47 respectively.
 - General shape; cylinder?
 - Member of Cosmos 699 class.

CAUSE: Apparently deliberate fragmentation.

Scatter plot showing the relationship between the Height of Apogee/Perigee (Y-axis) and the Period of Poor Quality (X-axis). The Y-axis ranges from 300 to 1100, and the X-axis ranges from 93 to 99. Data points are categorized into two groups: '+' and 'x'. The '+' group is clustered around a period of 450 and a height of 450. The 'x' group is clustered around a period of 750 and a height of 750. Both groups show a positive correlation between the two variables.

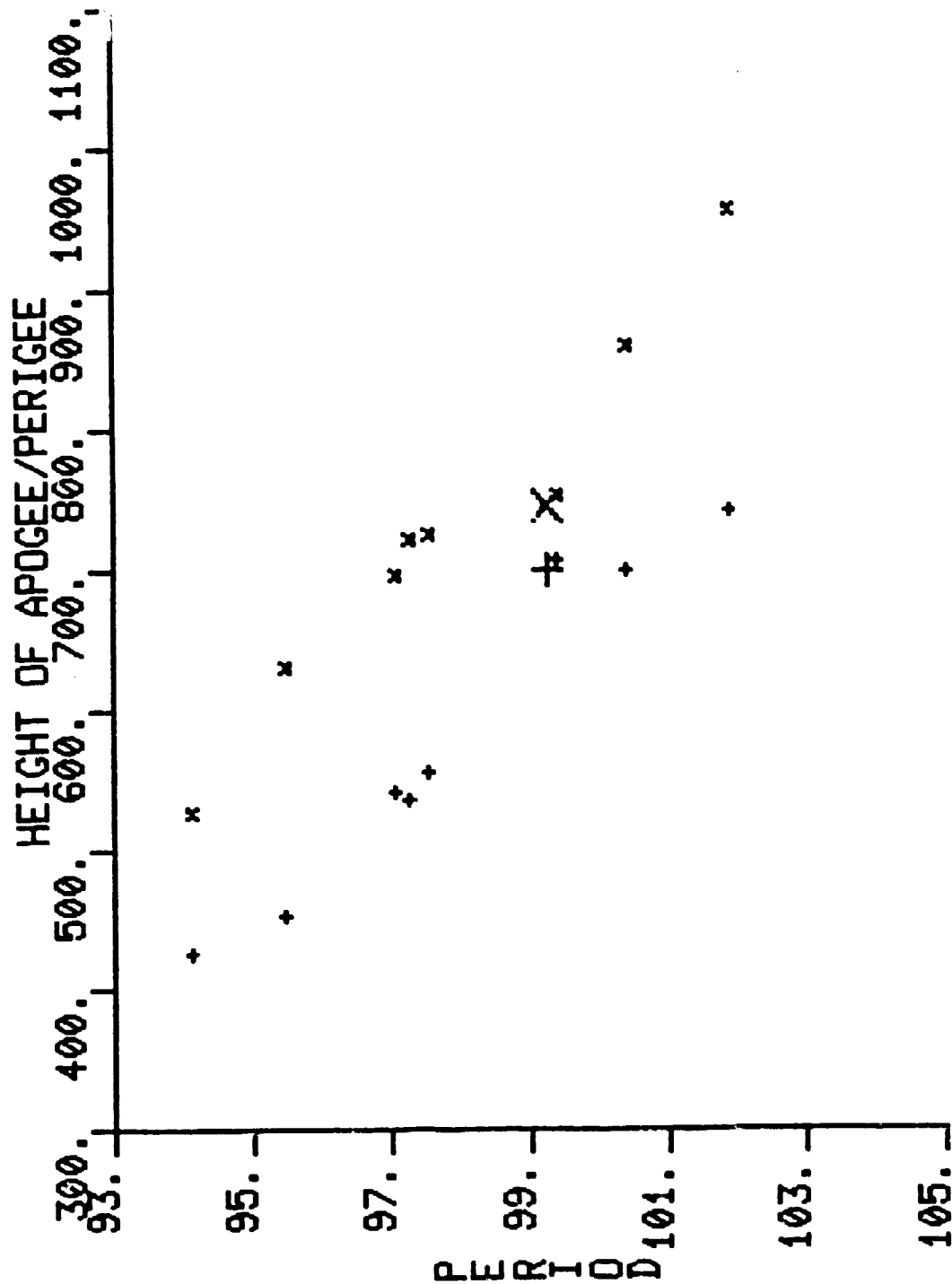
1-264

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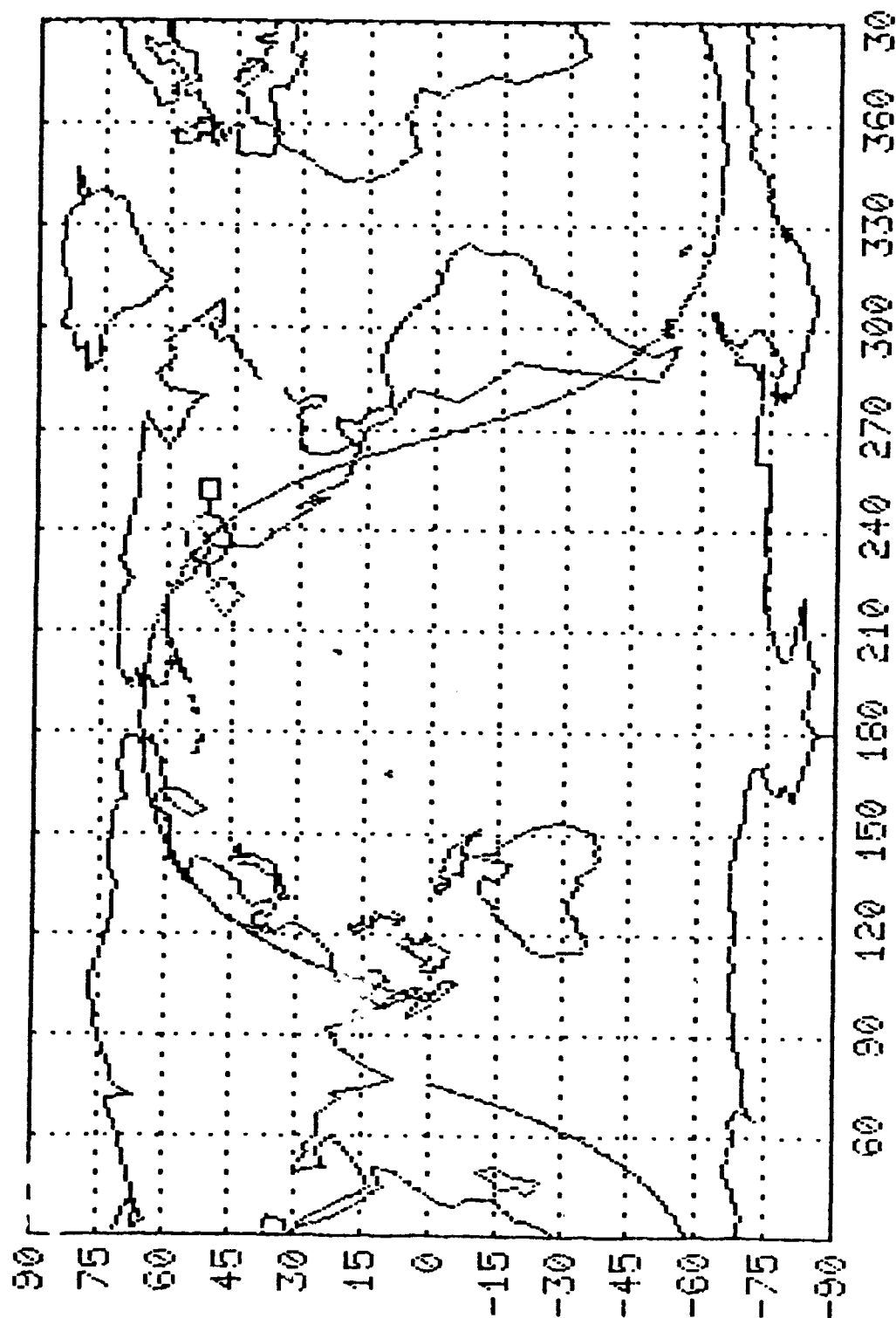
COSMOS 1260 (EVENT 1)

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COSMOS 1260
2ND EVENT

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COSMOS 1260 (EVENT 2)

1981-31

COSMOS 1261

12376

LAUNCH DATE: 31.41 Mar 1981

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 12 May 1981 (DAY 132)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 4

PIECES STILL IN ORBIT (1 JAN 84): 4

ORBIT CHARACTERISTICS:

INCLINATION: 63.04°

APOGEE: 39743 km

PERIGEE: 649 km

PERIOD: 718.5 min

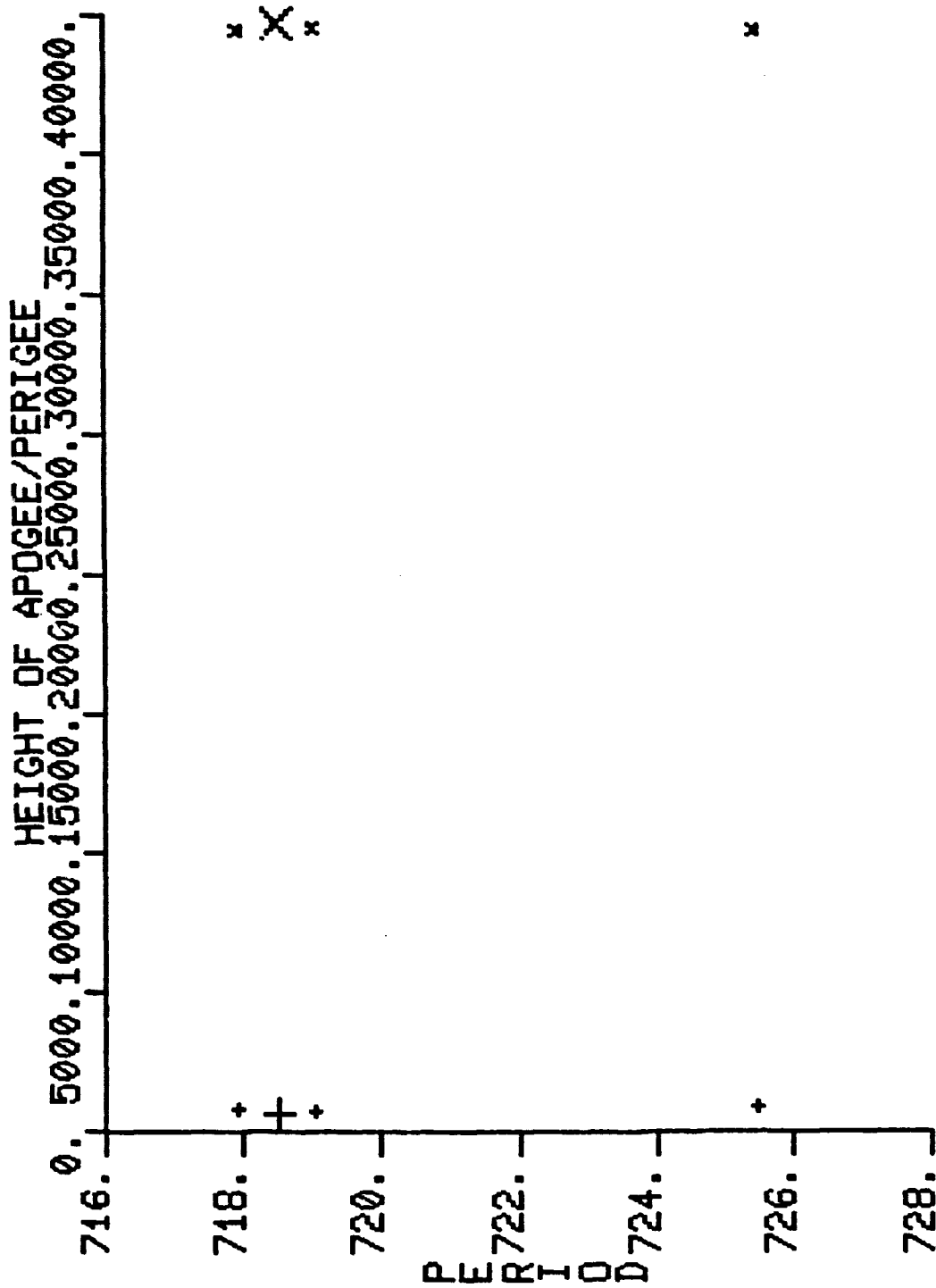
TRUE ANOMALY:

COMMENTS:

- Orbit data derived from element set #34 for satellite 12376.
- General shape was windmill plus 6 vanes?; length 4.2 m?; dia. 1.6 m; weight 1250 kg?

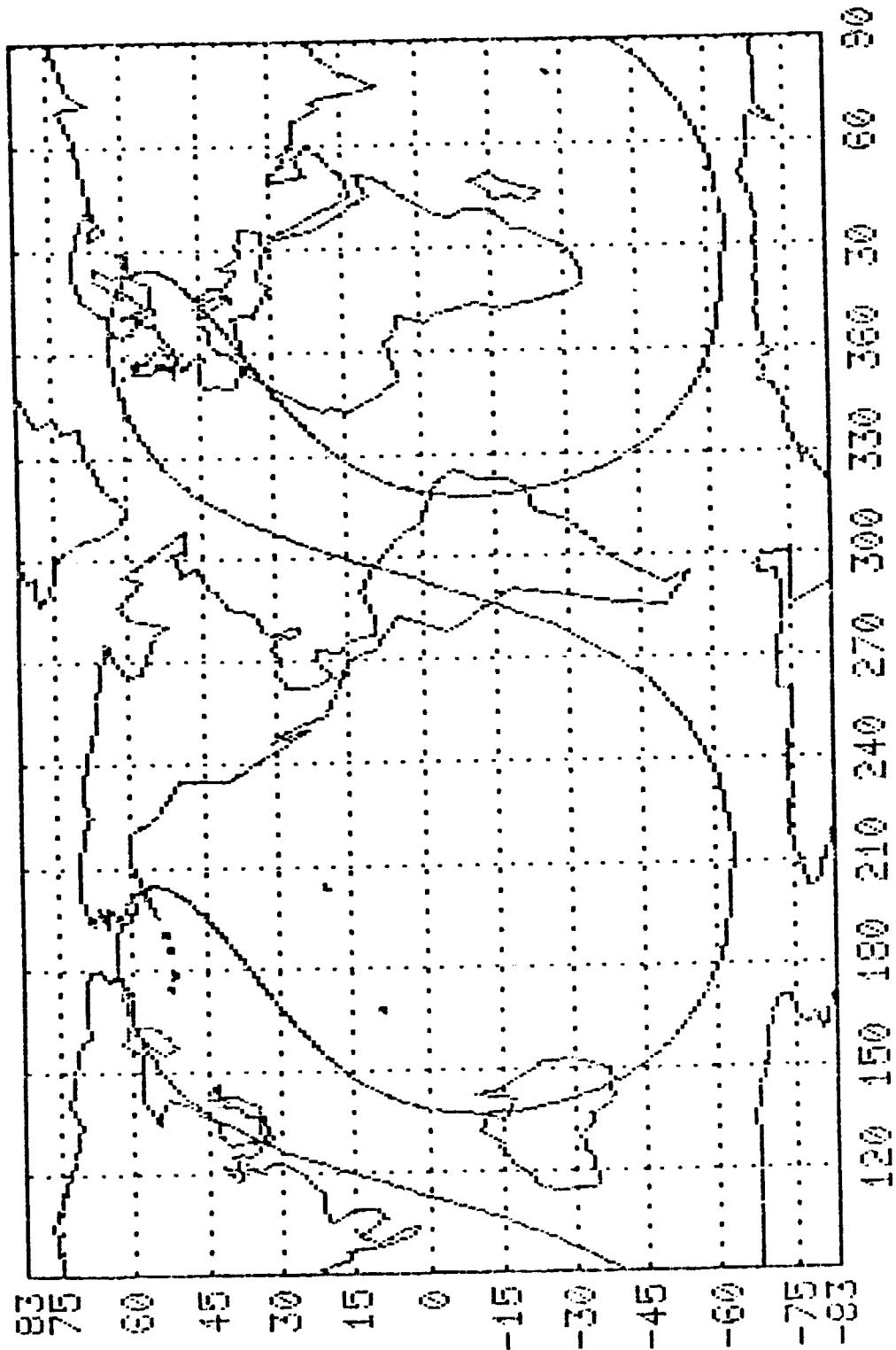
CAUSE: Unknown.

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COSMOS 1261

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COSMOS 1261

1981-53

COSMOS 1275

12504

LAUNCH DATE: 4.65 Jun 1981

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 24 Jul 1981 (DAY 205)

TIME: 235103.2 GMT

LOCATION: 68 N/197 E

ALTITUDE: 977 km

PIECES CATALOGED (1 JAN 84): 226

PIECES STILL IN ORBIT (1 JAN 84): 223

ORBIT CHARACTERISTICS:

INCLINATION: 82.96°

APOGEE: 1014 km

PERIGEE: 961 km

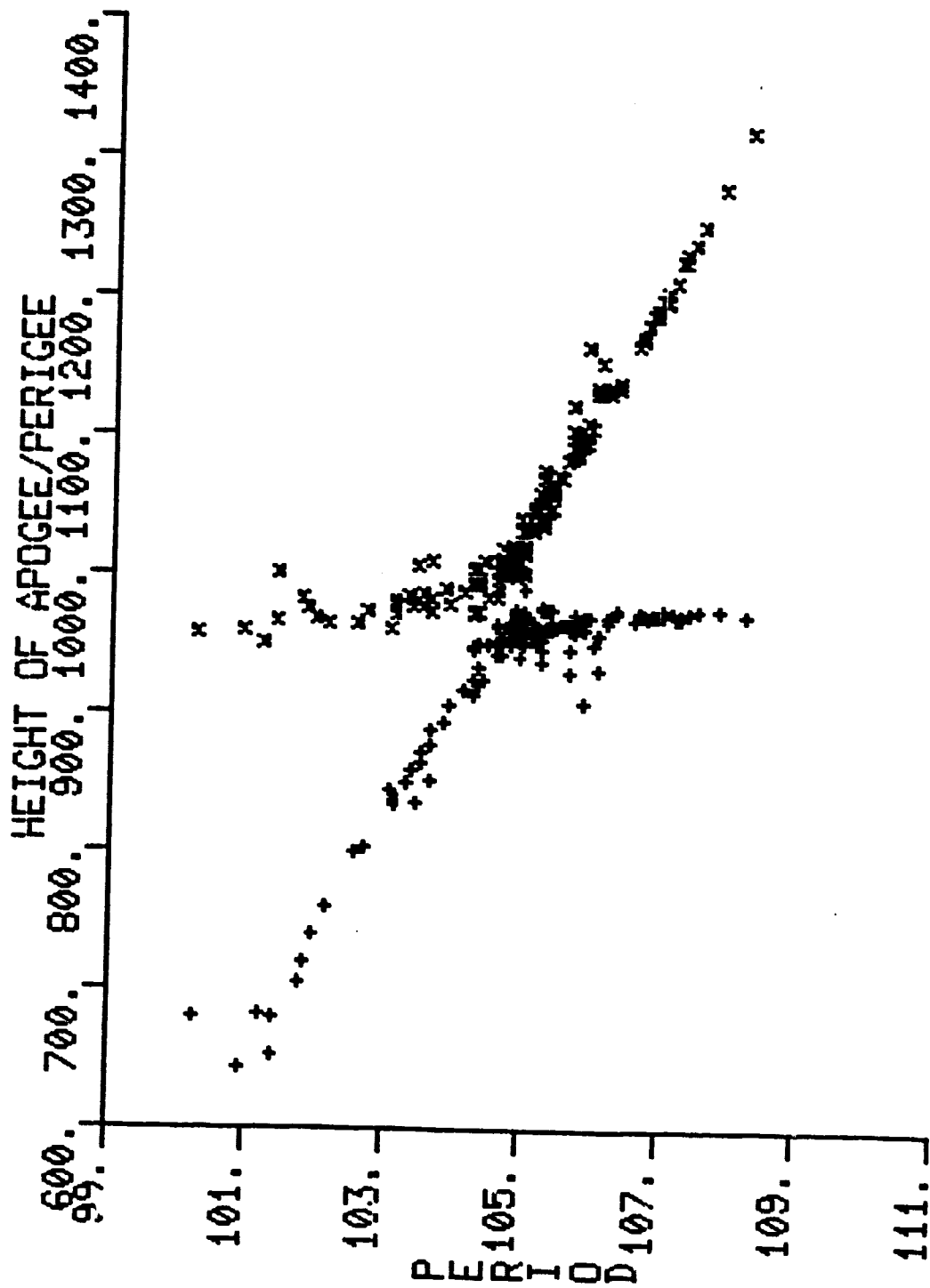
PERIOD: 104.8 min

TRUE ANOMALY: 292°

COMMENTS: • General shape was cylinder; length 1.3 m?; dia. 1.9 m?; weight 700 kg?

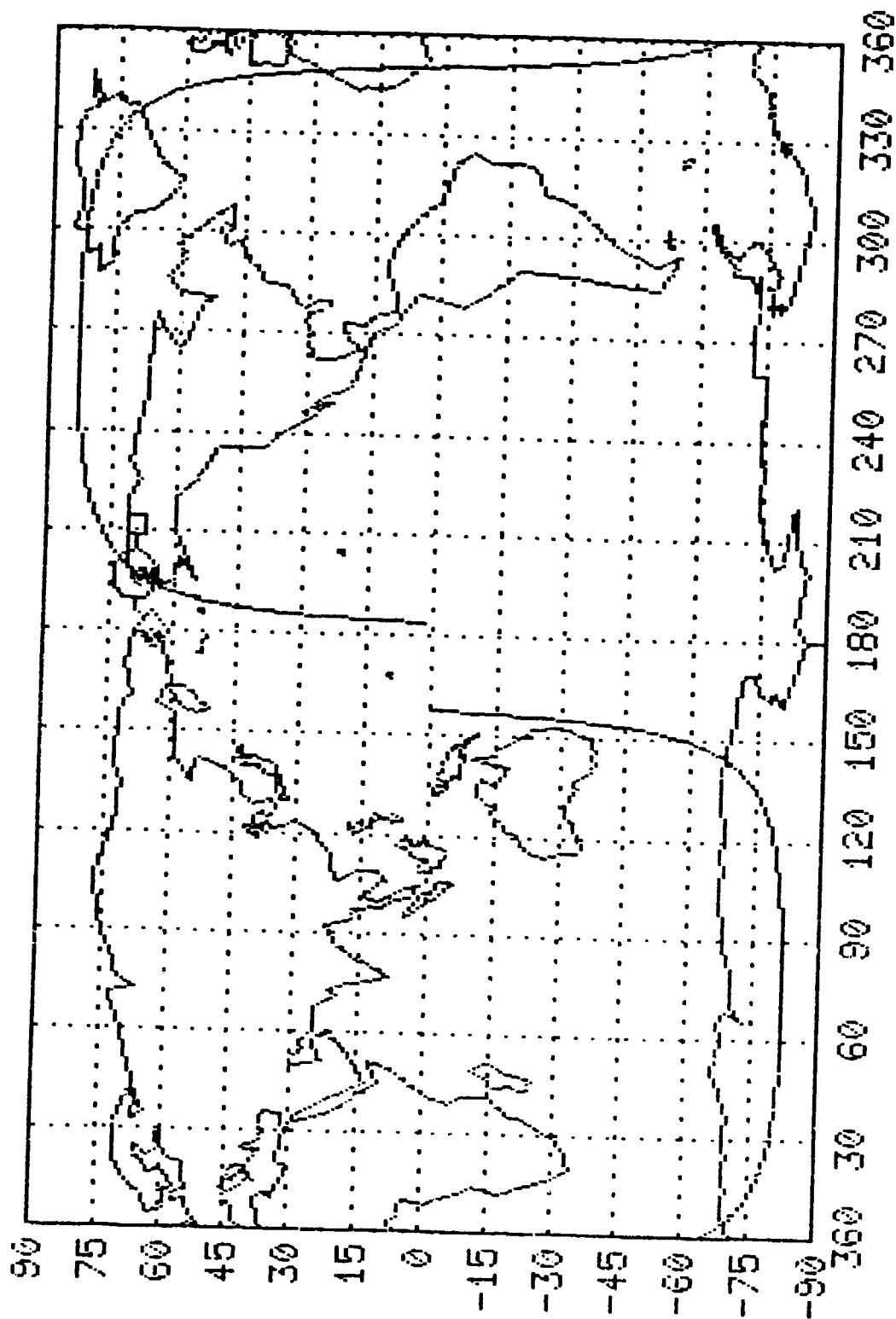
CAUSE: Unknown. See classified NORAD Technical Memorandum 81-5-3 for discussion. Title: "Fragmentation of USSR Satellites 11729 and 12504," dated May 1982. This document is on file at Teledyne Brown Engineering, Colorado Springs, Colorado.

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COSMOS 1275

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COSMOS 1275

1981-71

COSMOS 1285

12627

LAUNCH DATE: 4.01 Aug 1981

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 21 Nov 1981 (DAY 325)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 3

PIECES STILL IN ORBIT (1 JAN 84): 3

ORBIT CHARACTERISTICS:

INCLINATION: 63.11°

APOGEE: 40109 km

PERIGEE: 721 km

PERIOD: 727.4 min

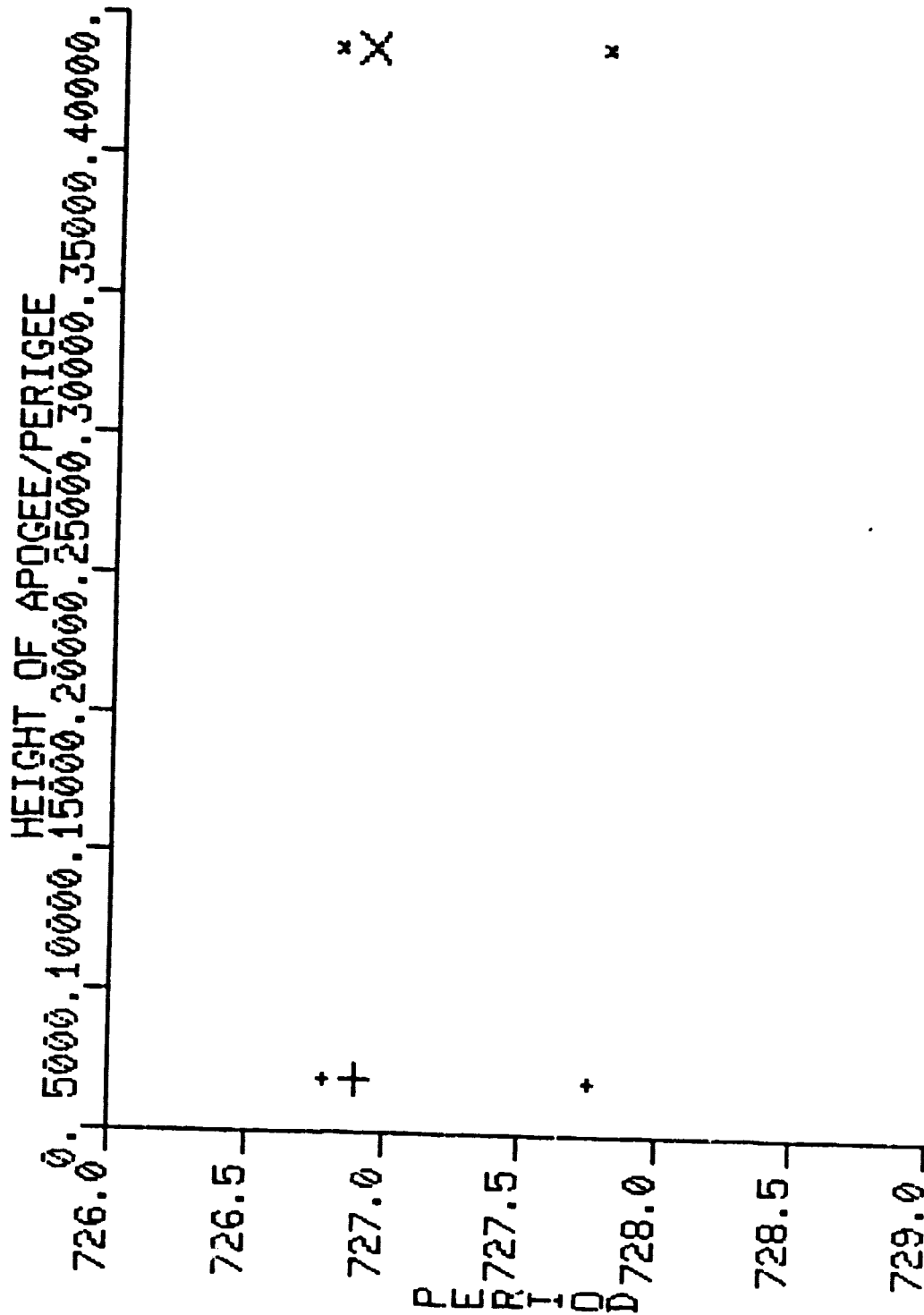
TRUE ANOMALY:

COMMENTS:

- General shape was windmill plus 6 vanes?; length 4.2 m; dia. 1.6 m?; weight 1250 kg?
- Orbit data derived from element set #95 for satellite 12627.

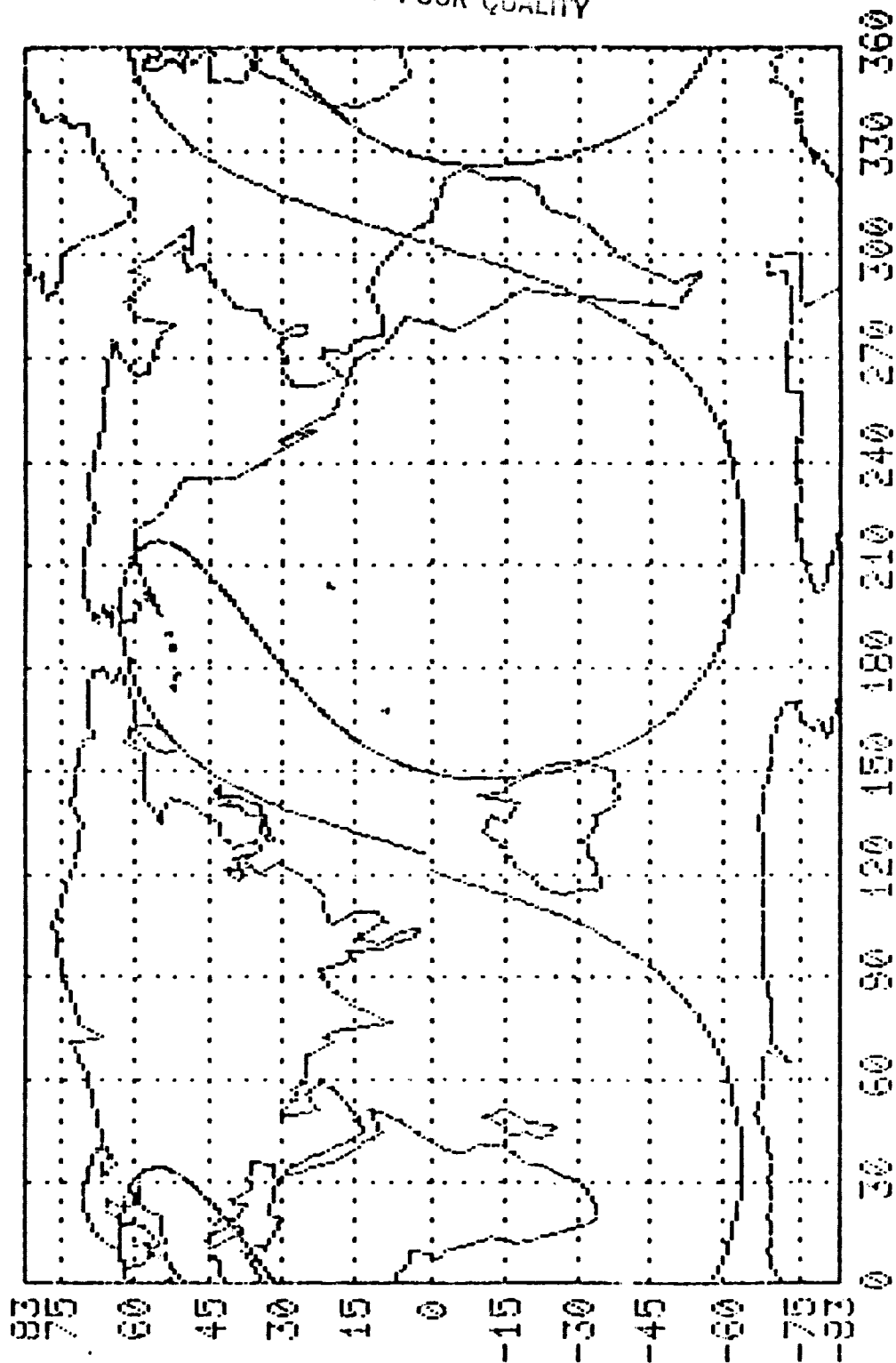
CAUSE: Unknown

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COSMOS 1285

ORIGINAL MAP
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COSMOS 1285

1981-72

COSMOS 1286

12631

LAUNCH DATE: 4.35 Aug 1981

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 29 Sep 1982 (DAY 272)

TIME: 051955.9 GMT

LOCATION: 51 N/80 E

ALTITUDE: 317 km

PIECES CATALOGED (1 JAN 84): 2

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 65.21°

APOGEE: 328 km

PERIGEE: 305 km

PERIOD: 92.6 min

TRUE ANOMALY: 251°

COMMENTS:

- Orbit data derived from element set #581 for satellite 12631.
- NORAD sensor personnel estimated 30 pieces but only one could be cataloged before decay.
- Member of Cosmos 699 class.

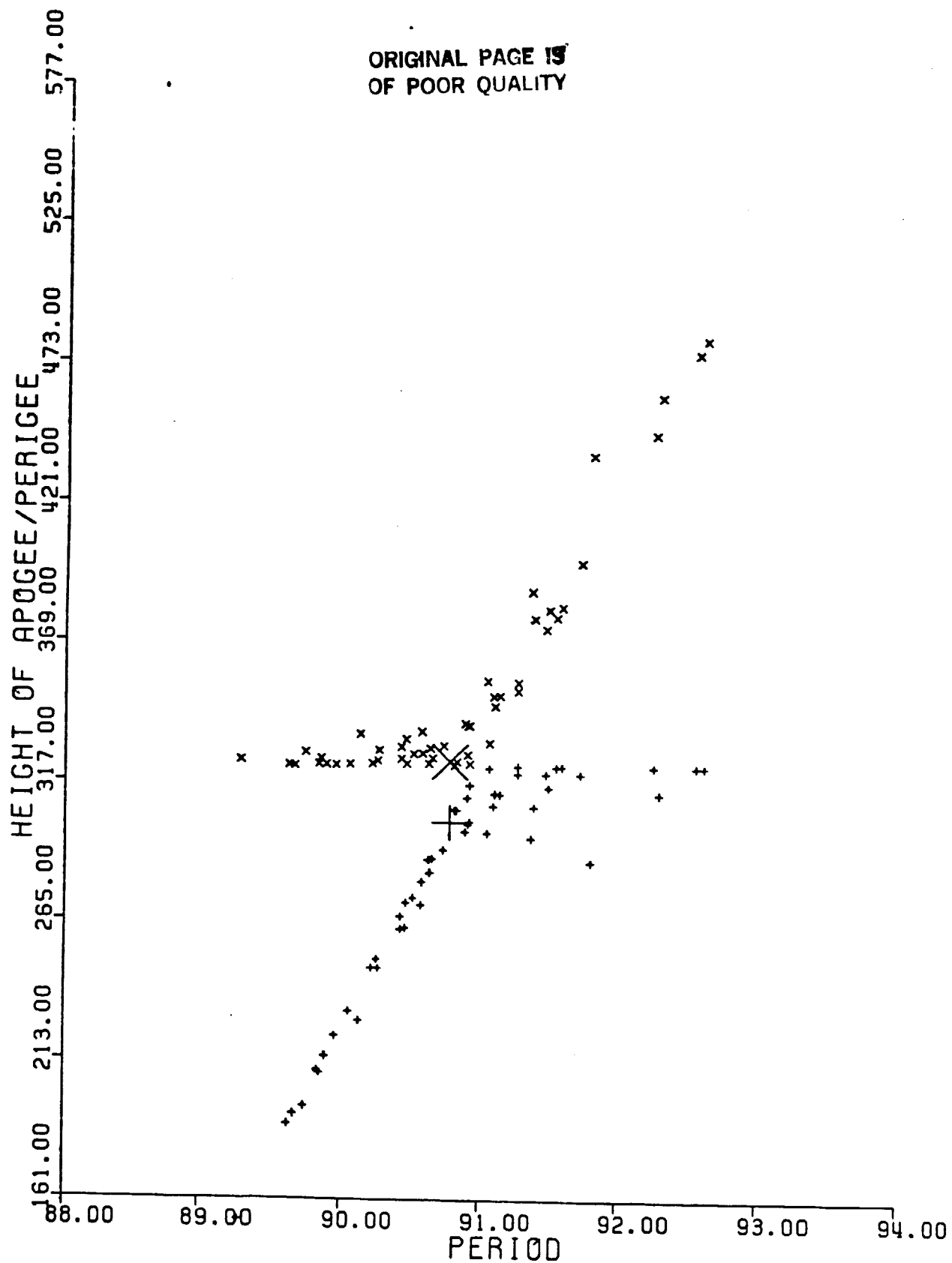
CAUSE: Apparently deliberate fragmentation.

1981-72

1-281

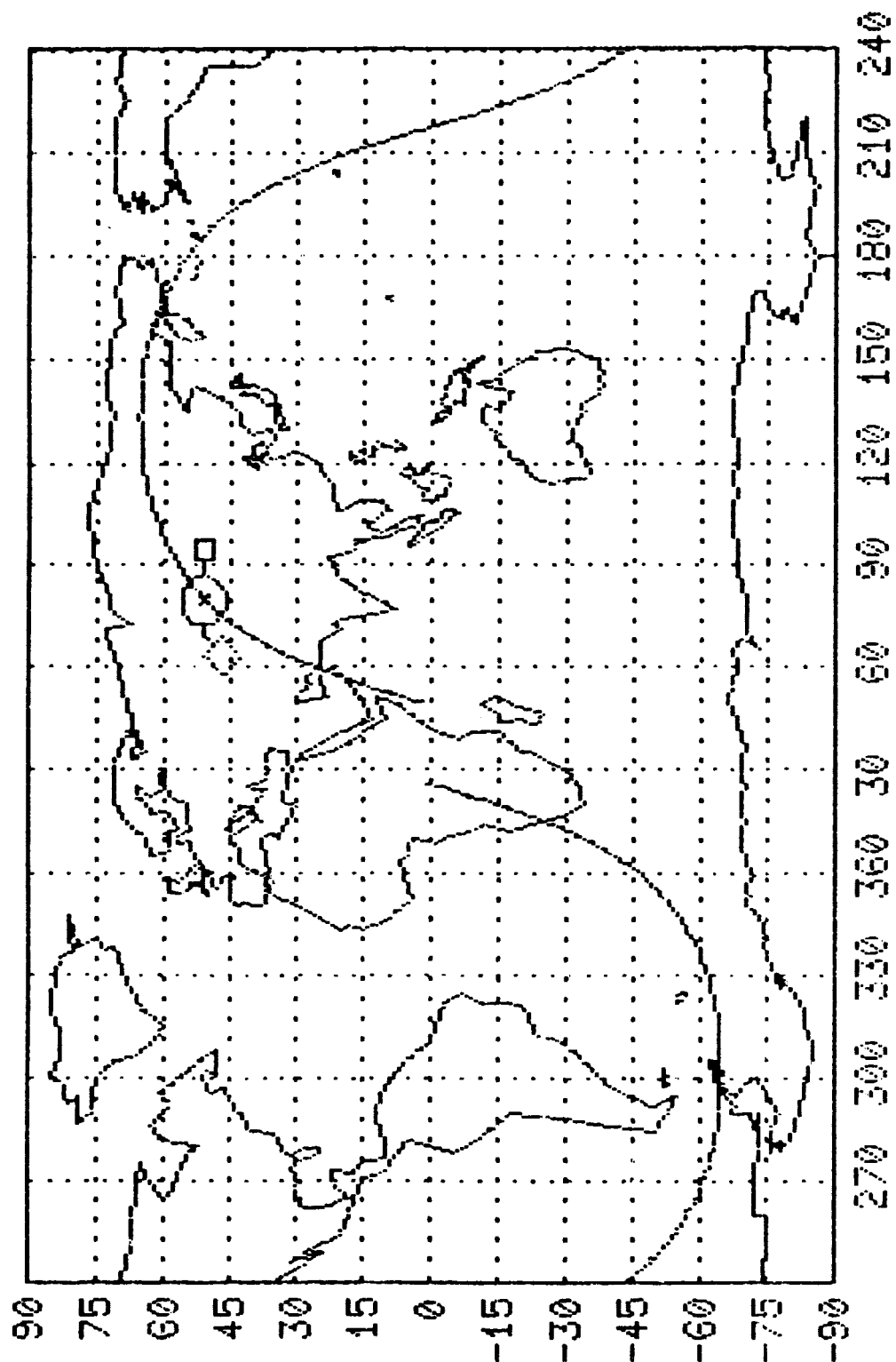
C-4

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COSMOS 1286 SIMULATION

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COSMOS 1286

1981-88

COSMOS 1305

12818

LAUNCH DATE: 11.37 Sep 1981

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 11 Sep 1981 (DAY 254)

TIME: 093631.1 GMT

LOCATION: 62 S/225 E

ALTITUDE: 649

PIECES CATALOGED (1 JAN 84): 2

PIECES STILL IN ORBIT (1 JAN 84): 2

ORBIT CHARACTERISTICS:

INCLINATION: 62.82°

APOGEE: 13864 km

PERIGEE: 626 km

PERIOD: 263.7 min

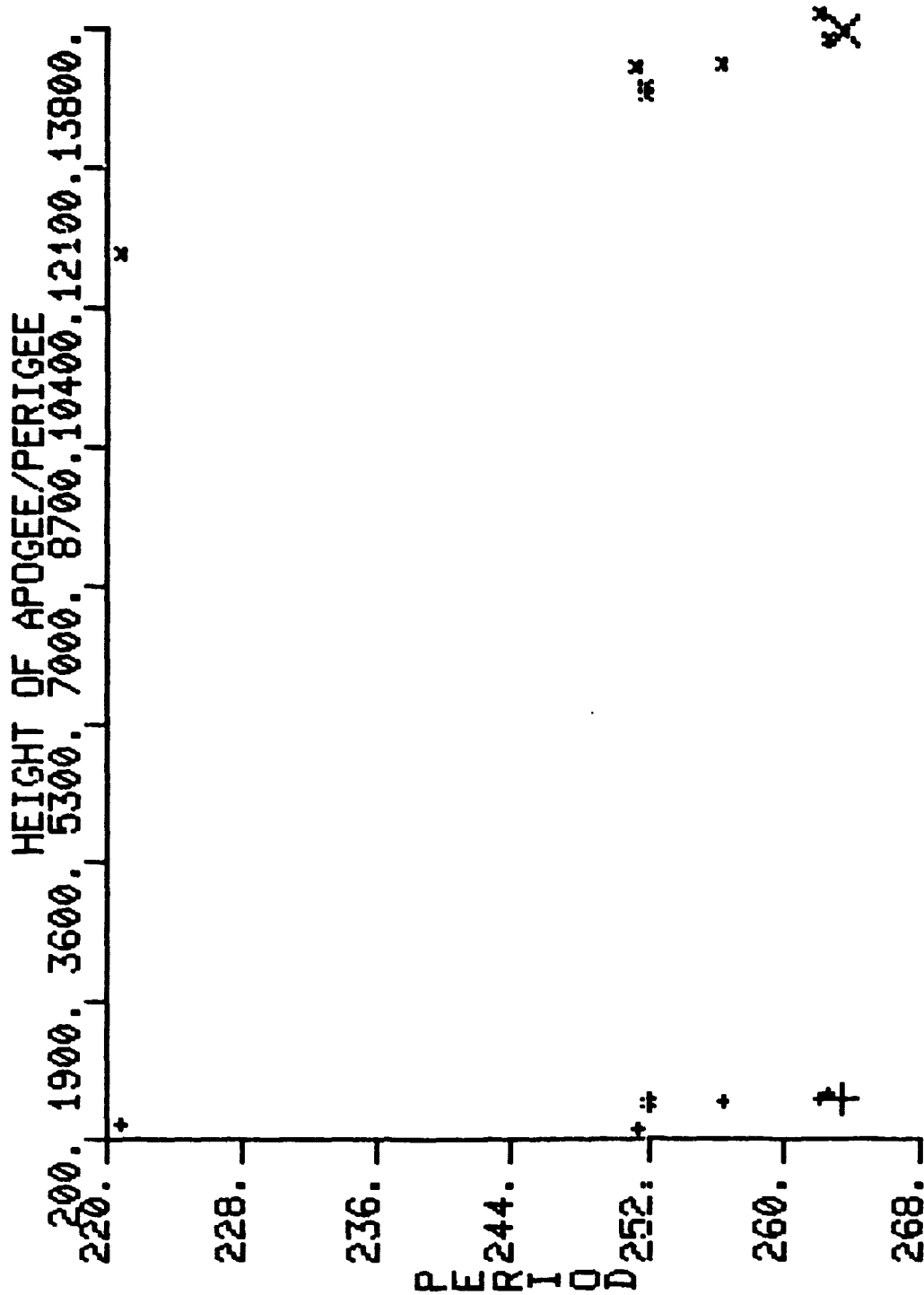
TRUE ANOMALY: 352

COMMENTS:

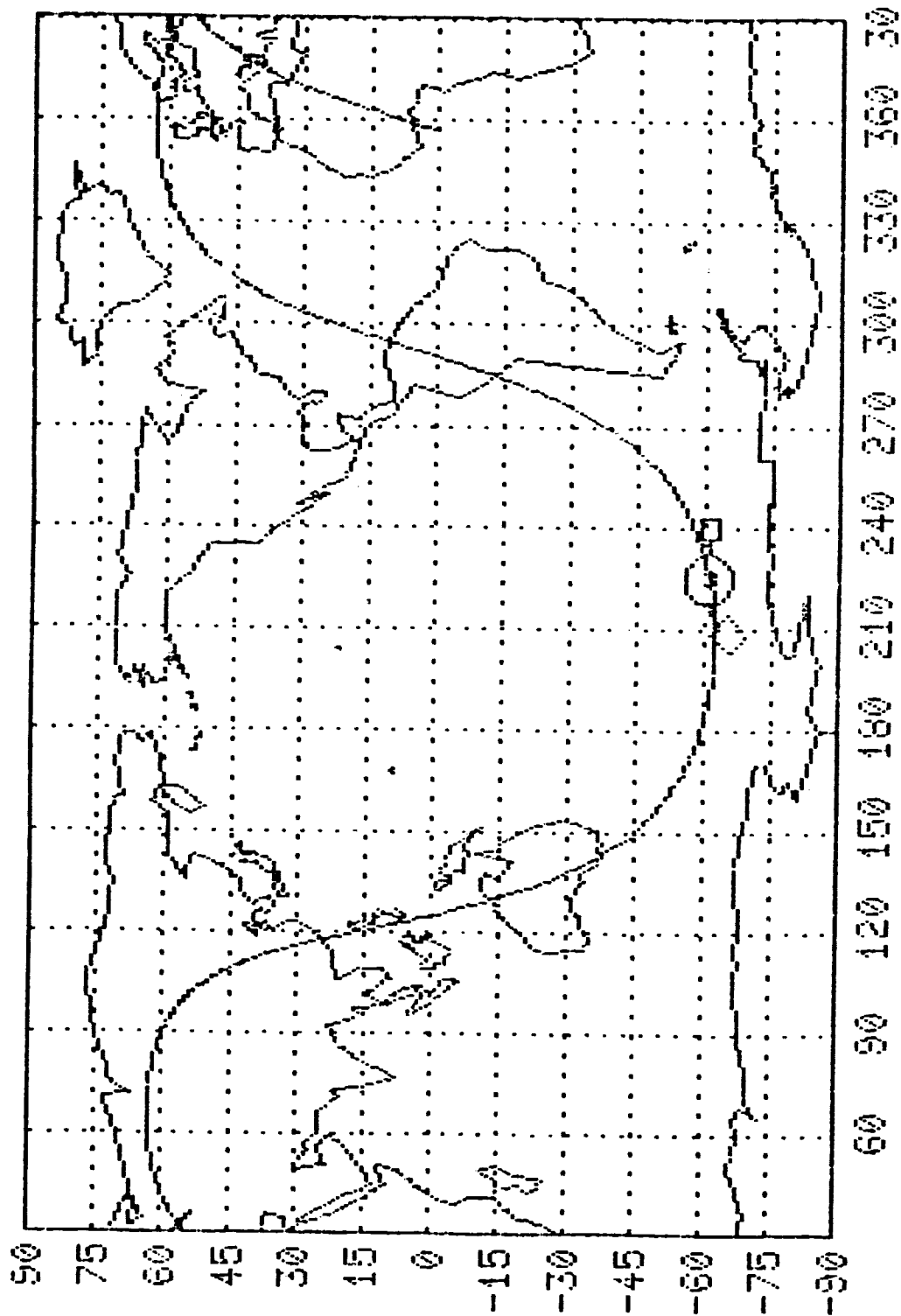
- Orbit data derived from element set #1 for satellite 12818.
- Four additional pieces noted but not cataloged at this time.

CAUSE: Rocket malfunction during a transfer orbit attempt.

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COSMOS 1305

1981-89

COSMOS 1306

12828

LAUNCH DATE: 14.86 Sep 1981

COUNTRY OF ORIGIN: USSR

EVENT DATA: 1.

2.

DATE: 12 Jul 1982 (DAY 193)

18 Sep 1982 (DAY 261)

TIME: 232436.0 GMT

170141.5 GMT

LOCATION: 65 S/40 E

32 N/293 E

ALTITUDE: 380 km

370 km

PIECES CATALOGED (1 JAN 84): 6

1

PIECES STILL IN ORBIT (1 JAN 84): 1

0

ORBIT CHARACTERISTICS:

INCLINATION: 64.94°

64.94°

APOGEE: 407 km

372 km

PERIGEE: 380 km

369 km

PERIOD: 92.4 min

92.0 min

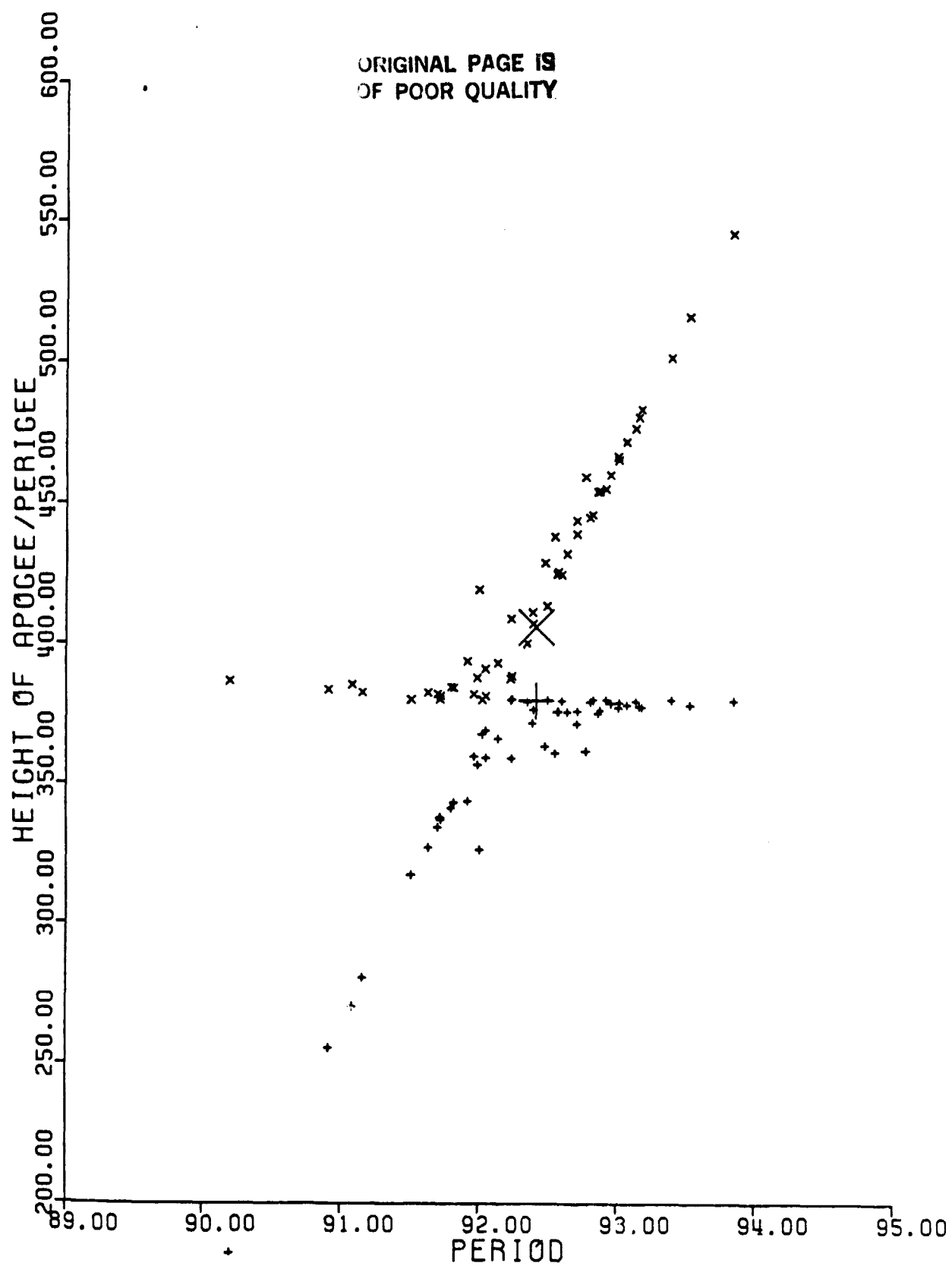
TRUE ANOMALY: 347°

81°

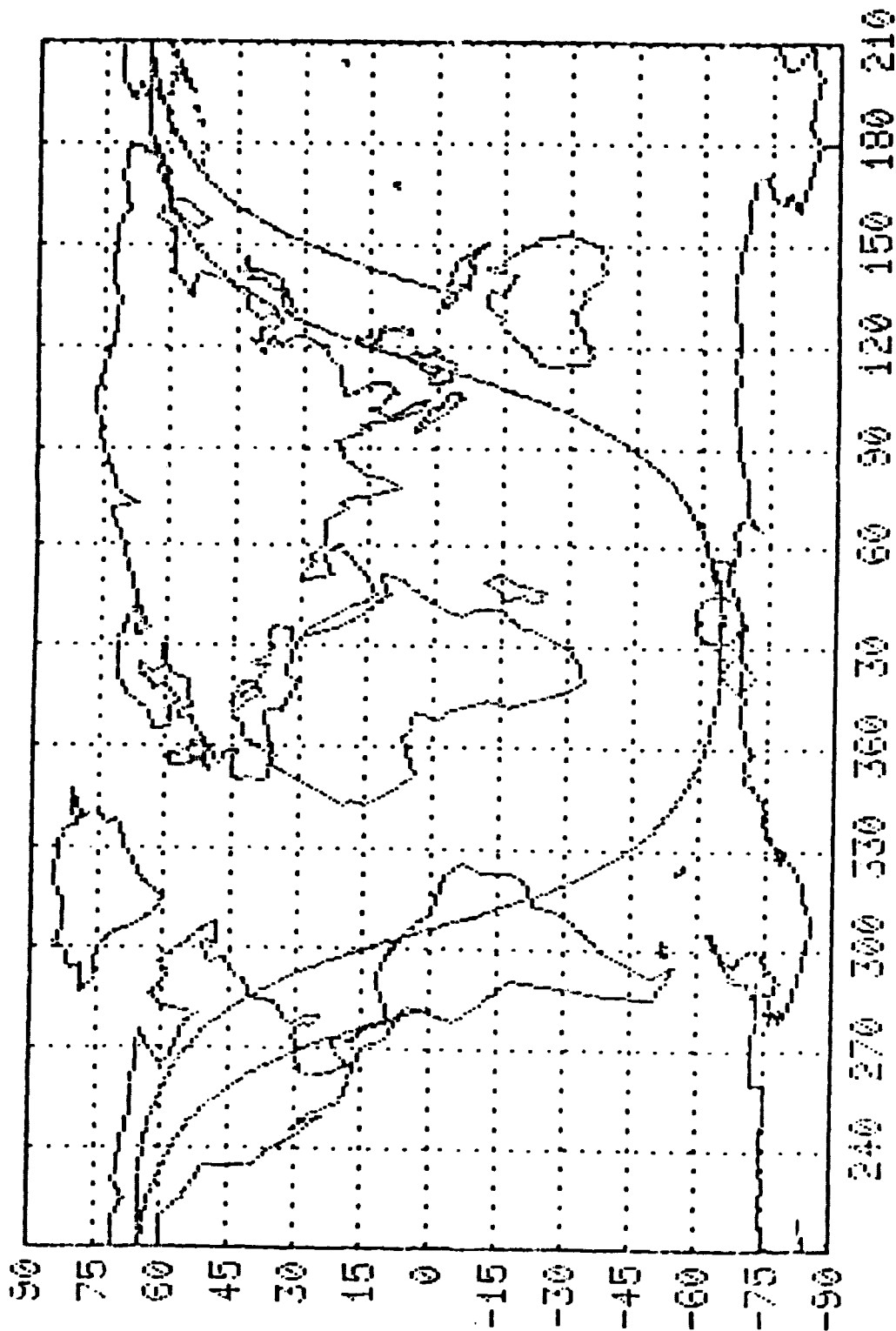
- COMMENTS:**
- Two fragmentation events.
 - For the first event NORAD sensor personnel counted 27 pieces but most decayed before they could be cataloged. A large fragment was given the number of the original parent, 12828, and it decayed 16 July 1982. One piece of debris from the first event, satellite 13369, fragmented 18 Sept 1982.
 - Four cataloged pieces from the 1st event had not decayed by time of 2nd event.
 - Orbit data derived from element sets #302 and #85 for satellites 12828 and 13369 respectively.
 - 25 provisional element sets were developed on fragments from these events.
 - Member of Cosmos 699 class.

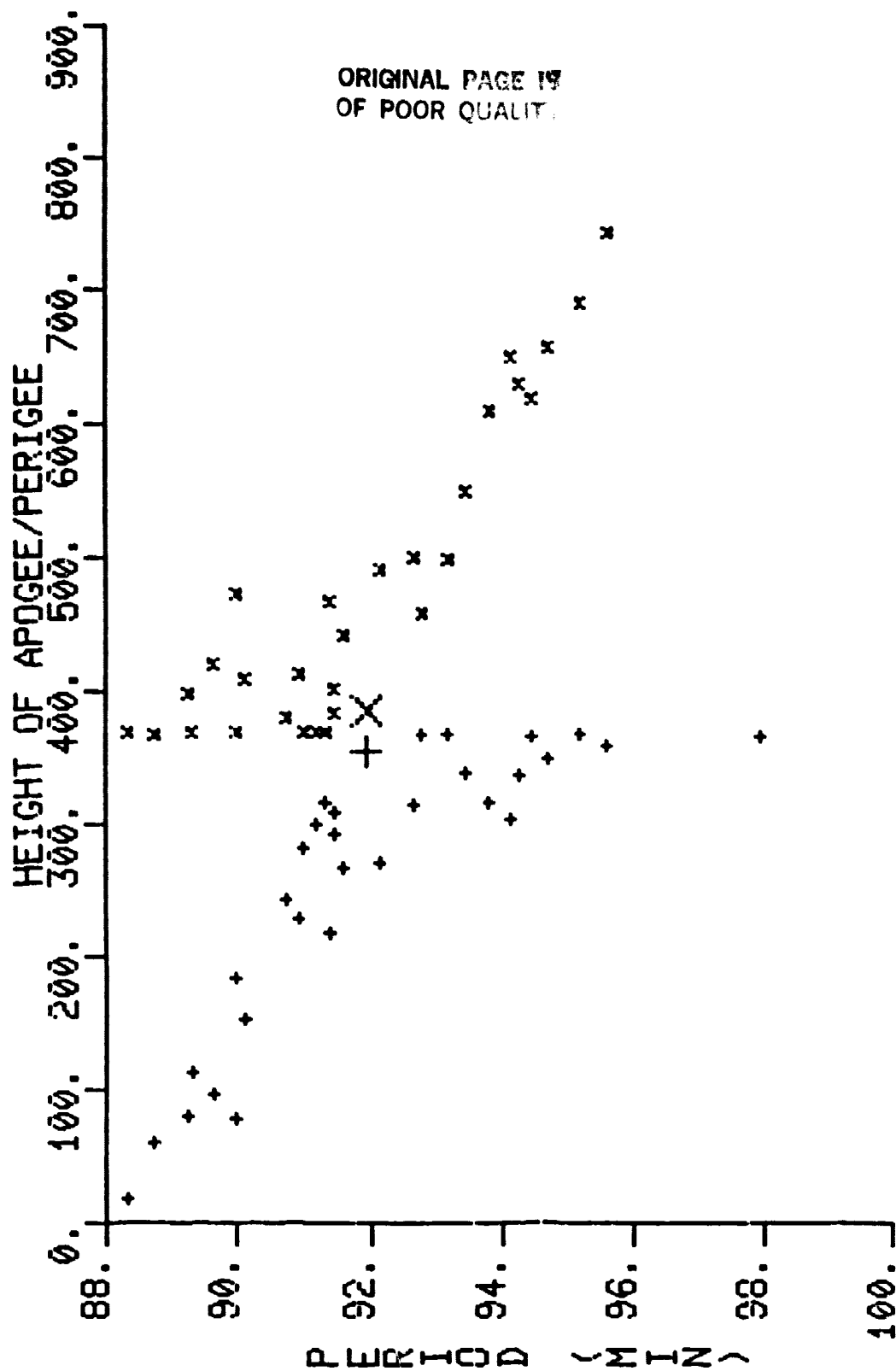
CAUSE: Apparently deliberate fragmentations.

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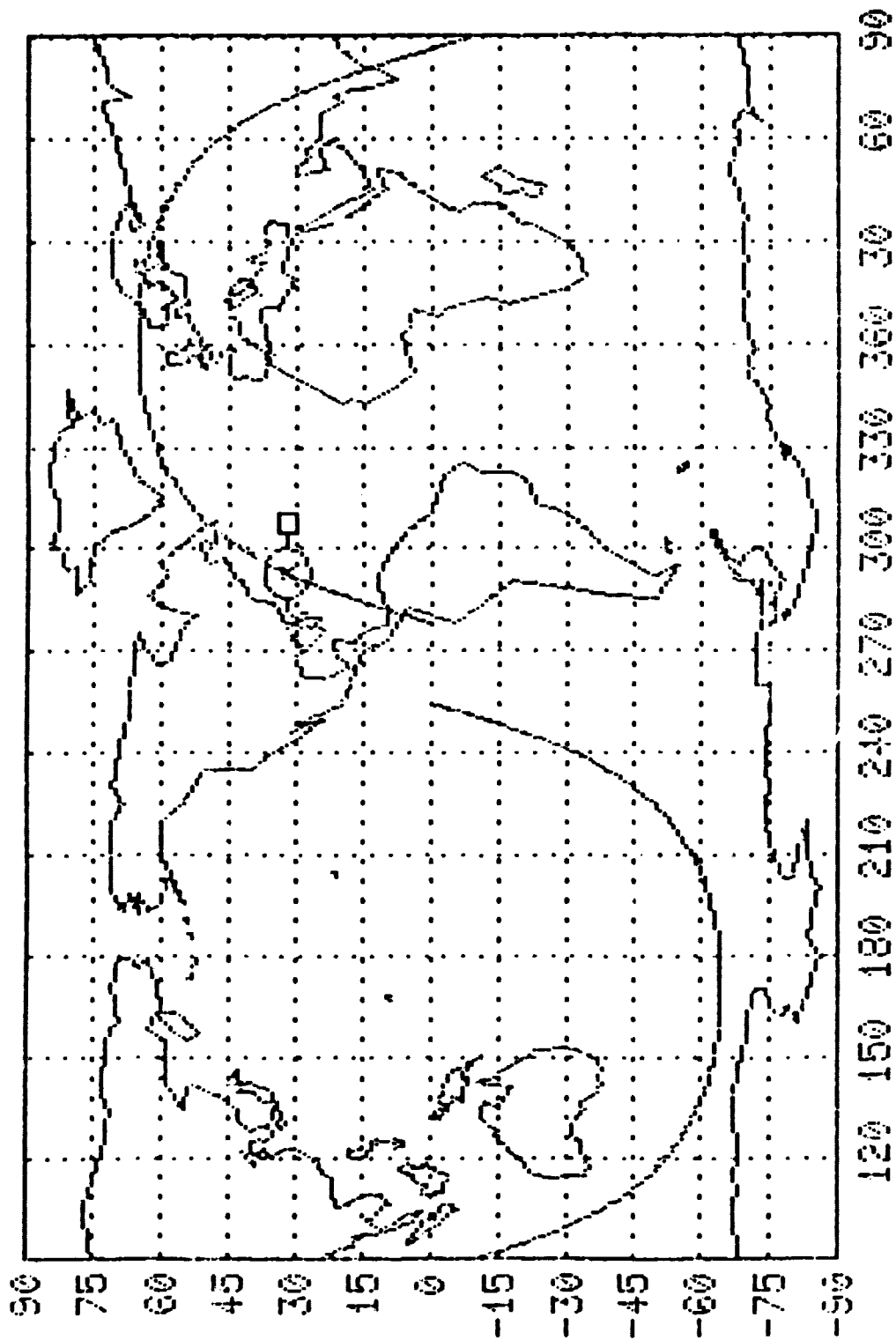
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COSMOS 1306 SIMULATION
2ND EVENT

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COSMOS 1306 (2ND EVENT)

1981-108

COSMOS 1317

12933

LAUNCH DATE: 31.96 Oct 1981

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 25-28 Jan 1984 (Day 25-28)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 MAR 84): 6 (3 cataloged plus 3 more provisional)

PIECES STILL IN ORBIT (1 MAR 84): 6

ORBIT CHARACTERISTICS:

INCLINATION: 62.8°

APOGEE: 39085.2 km

PERIGEE: 1318.9 km

PERIOD: 718.8 min

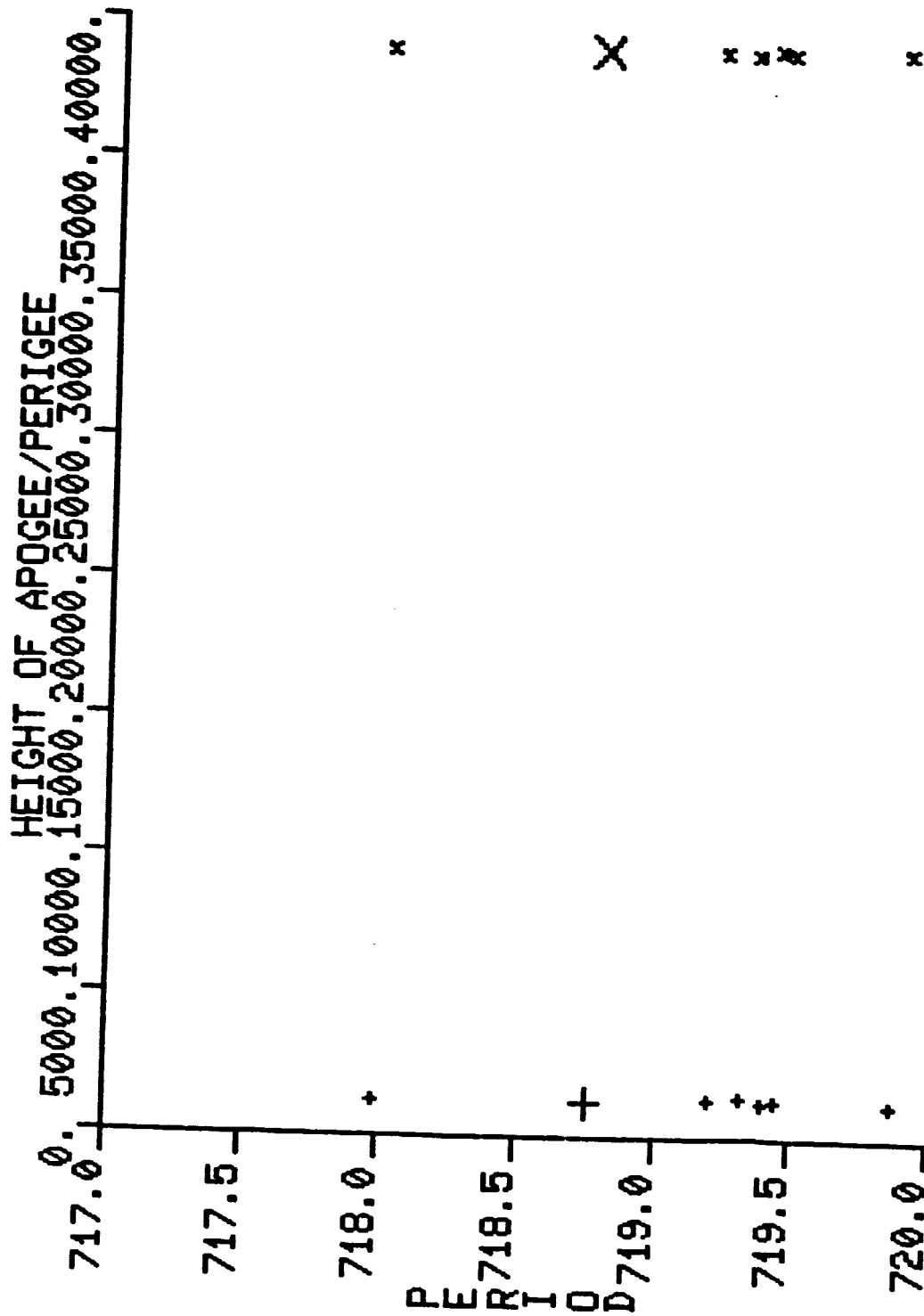
TRUE ANOMALY:

COMMENTS: • General shape; windmill plus 6 vanes; 4.2 m long?; 1.6 m
 dia.; weight 1250? kg.

 • Element data derived from NSCC elements on satellite 12933
 epoch 1984 day 26.45925295.

CAUSE: Unknown.

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COMMENTS • Insufficient data available to show applicable ground trace for satellite 12933.

1981-108

1982-38

COSMOS 1355

13150

LAUNCH DATE: 29.42 Apr 1982

COUNTRY OF ORIGIN: USSR

EVENT DATA:

	<u>1.</u>	<u>2.</u>	<u>3.</u>
DATE:	8 Aug 1983 (DAY 220)	1 Feb 1984 (DAY 32)	21 Feb 1984 (DAY 52)
TIME:	233058.0 GMT	032157.1 GMT	
LOCATION:	32 S/310 E	4 S/200 E	
ALTITUDE:	364 km	317 km	
PIECES CATALOGED (1 JAN 84):	22		
PIECES STILL IN ORBIT (1 JAN 84):	3		

ORBIT CHARACTERISTICS:

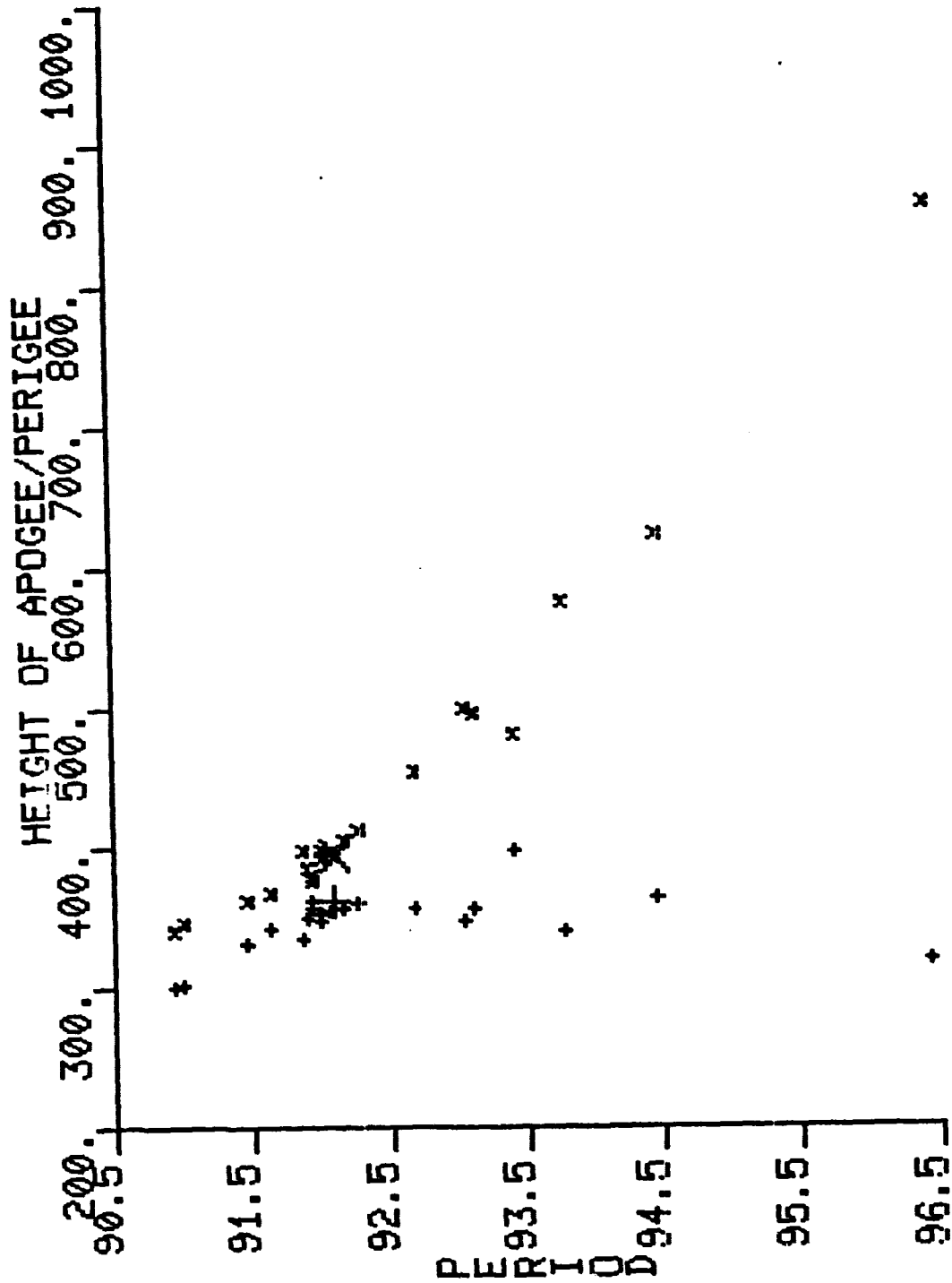
INCLINATION:	65.05°	65.04°	65.04°
APOGEE:	395 km	330 km	307 km
PERIGEE:	362 km	308 km	289 km
PERIOD:	92.1 min	90.9 min	90.5 min
TRUE ANOMALY:	32°	79°	

COMMENTS: • Orbit data derived from element set #632 for satellite 13150, 1st event; element set #242 for 2nd event, satellite 14275 and elements generated on day 51.19, Feb. 19, 1984 on satellite 13150 for the 3rd event.

- The 1st and 3rd fragmentation was satellite 13150 and the 2nd fragmentation was satellite 14275.
- Thirteen fragments were detected after 3rd event.
- Member of Cosmos 699 class.

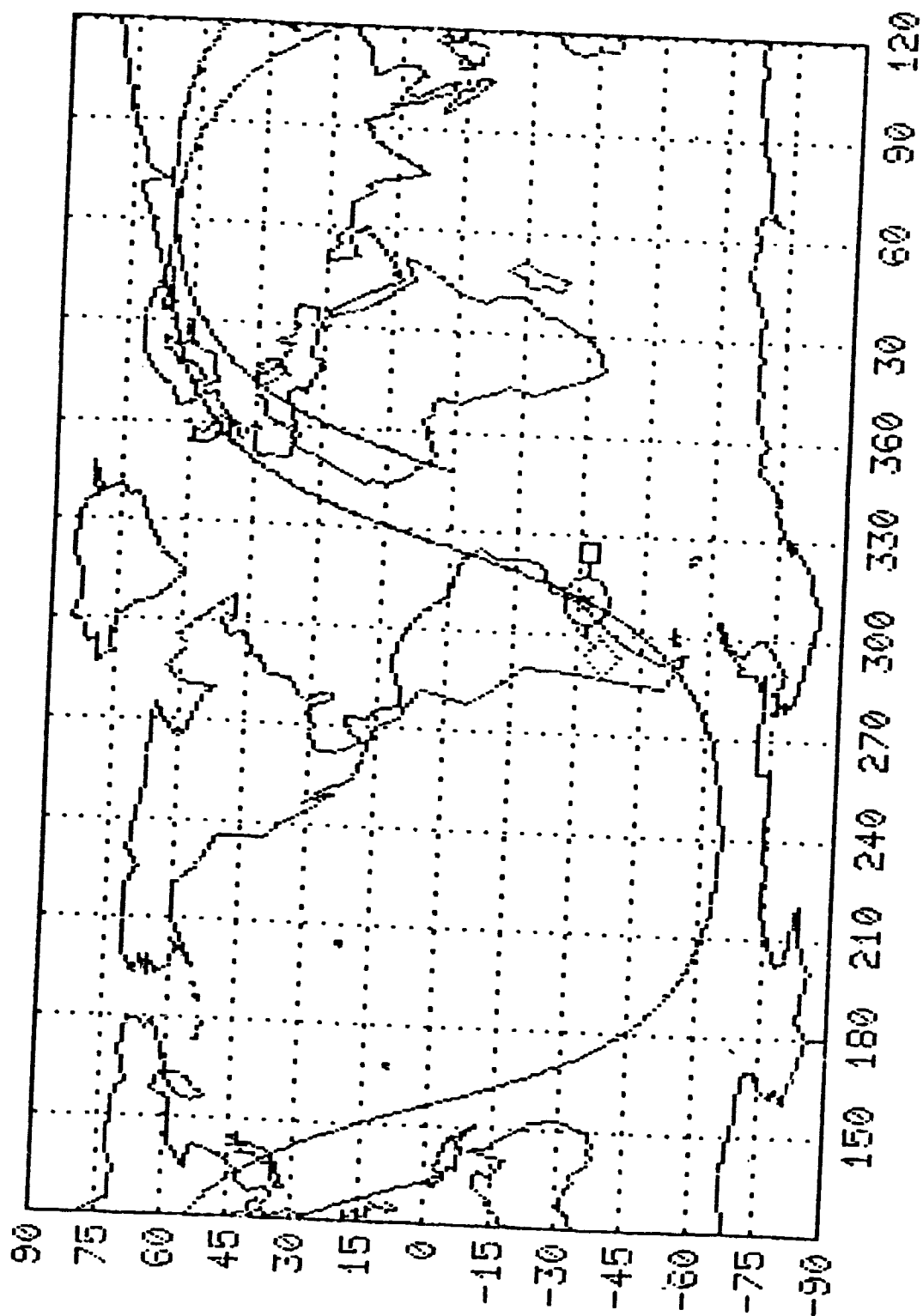
CAUSE: Apparently deliberate fragmentations.

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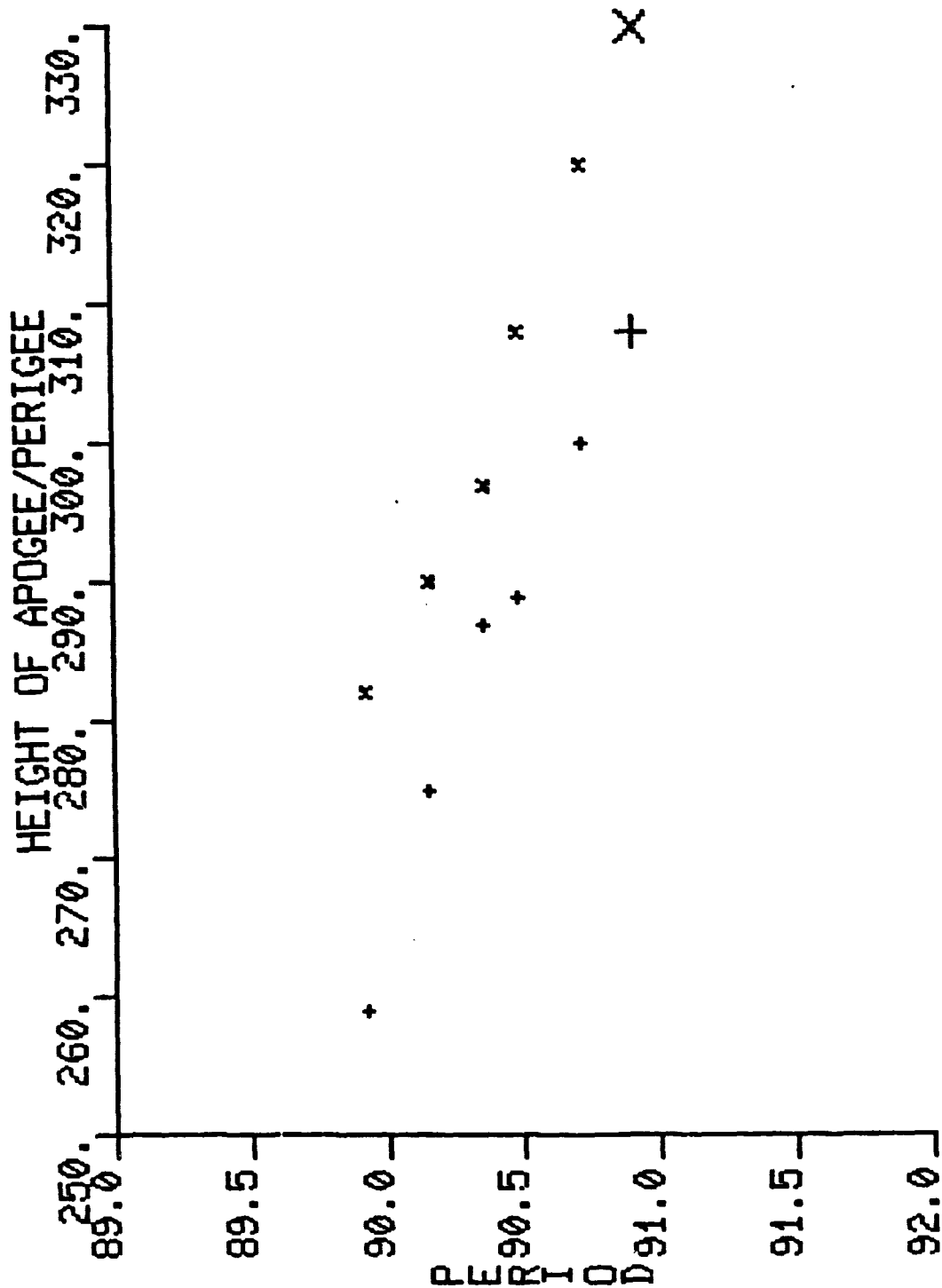
COSMOS 1355
1st EVENT

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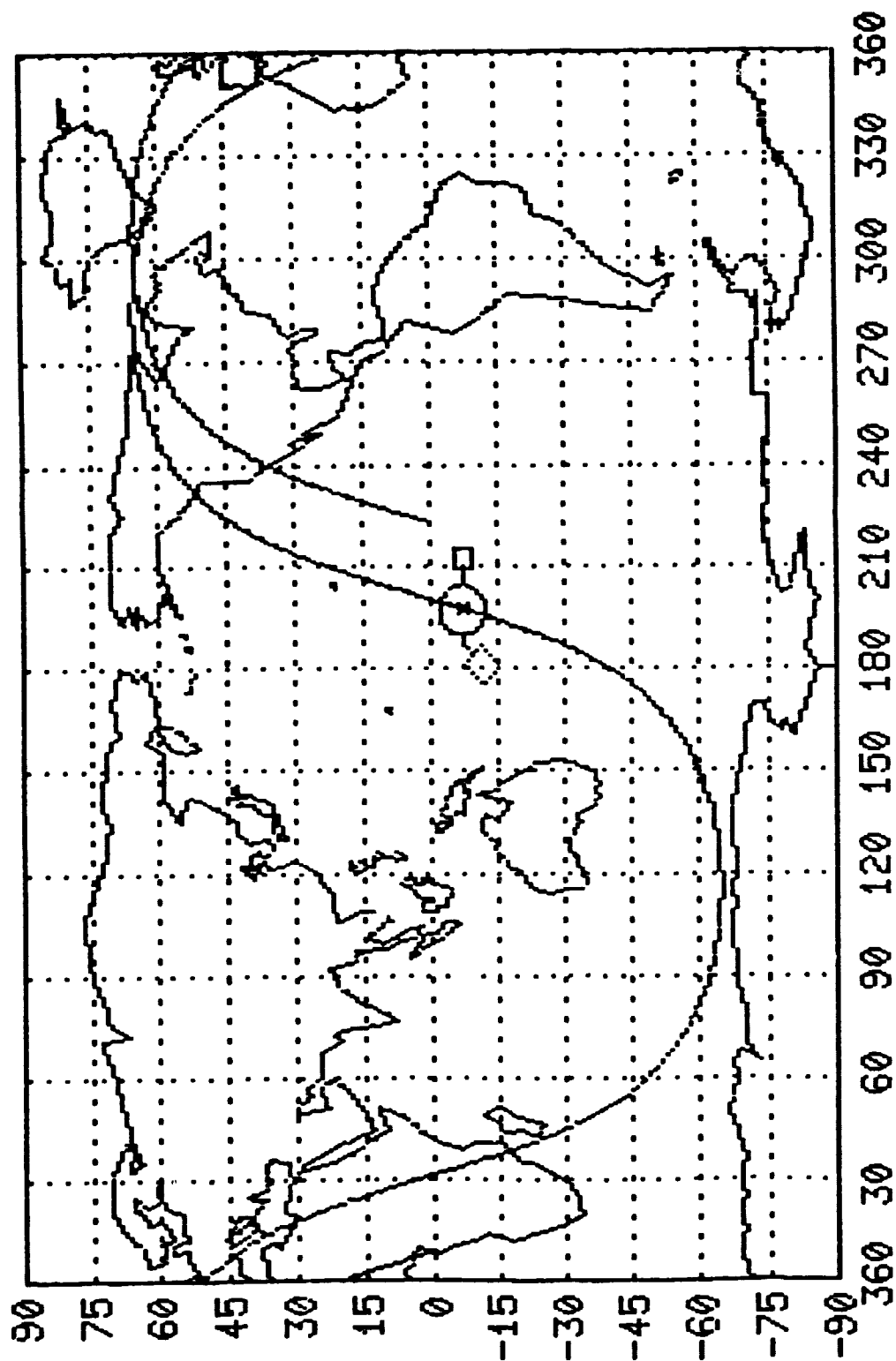
COSMOS 1355 (1st EVENT)

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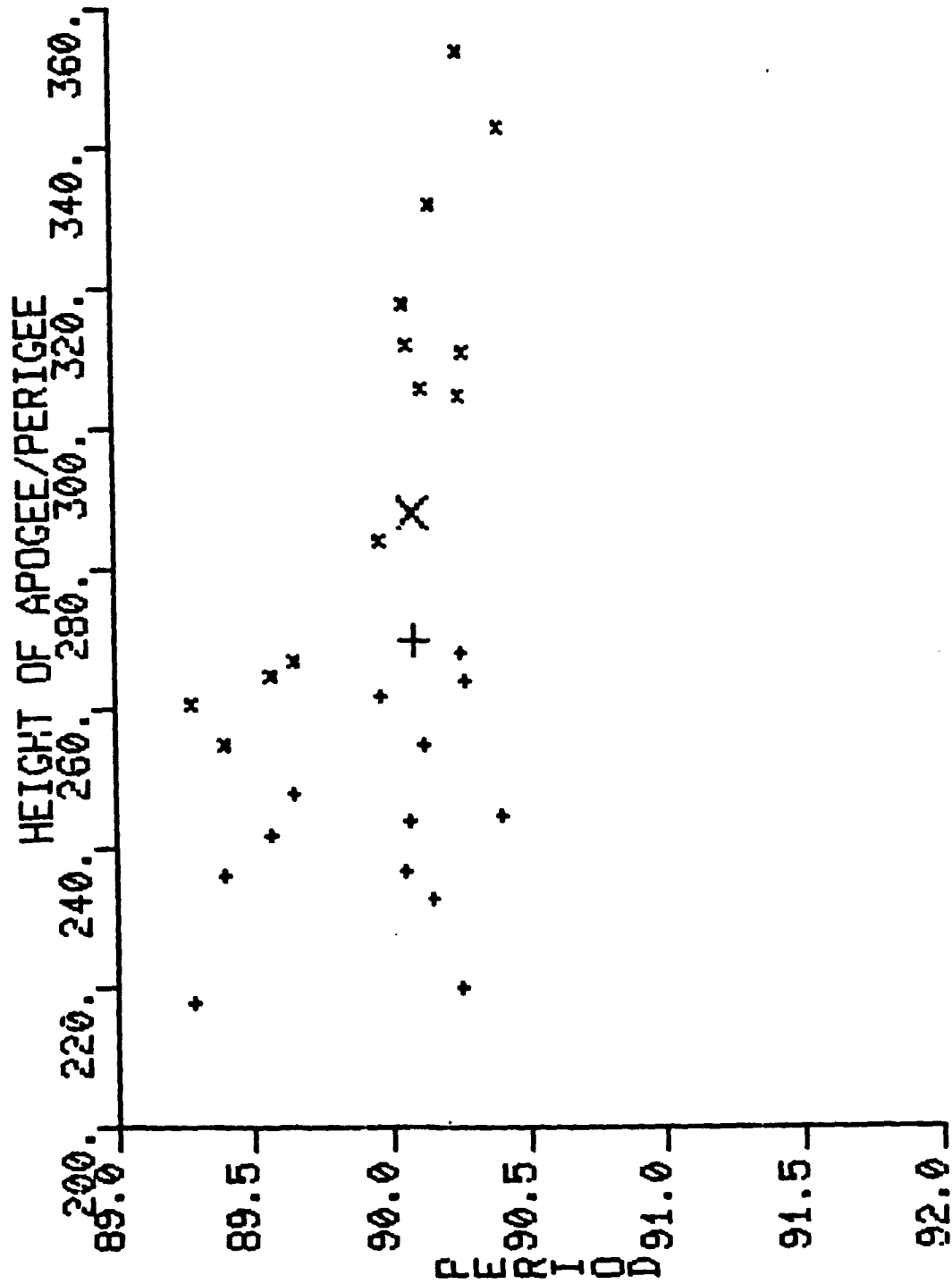
COSMOS 1355
2ND EVENT

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COSMOS 1355 (2ND EVENT)

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COSMOS 1355
3RD EVENT

COMMENTS: • Insufficient data available to show applicable ground trace for COSMOS 1355 - 3rd event.

1982-88

COSMOS 1405

13508

LAUNCH DATE: 4.74 Sep 1982

COUNTRY OF ORIGIN:

EVENT DATA:

DATE: 20 Dec 1983 (DAY 354)

TIME: 121434.0 GMT

LOCATION: 25 S/45 E

ALTITUDE: 333 km

PIECES CATALOGED (1 JAN 84): 5 (others cataloged after 1 Jan)

PIECES STILL IN ORBIT (1 JAN 84): 5

ORBIT CHARACTERISTICS:

INCLINATION: 65.00°

APOGEE: 342 km

PERIGEE: 315 km

PERIOD: 91.1 min

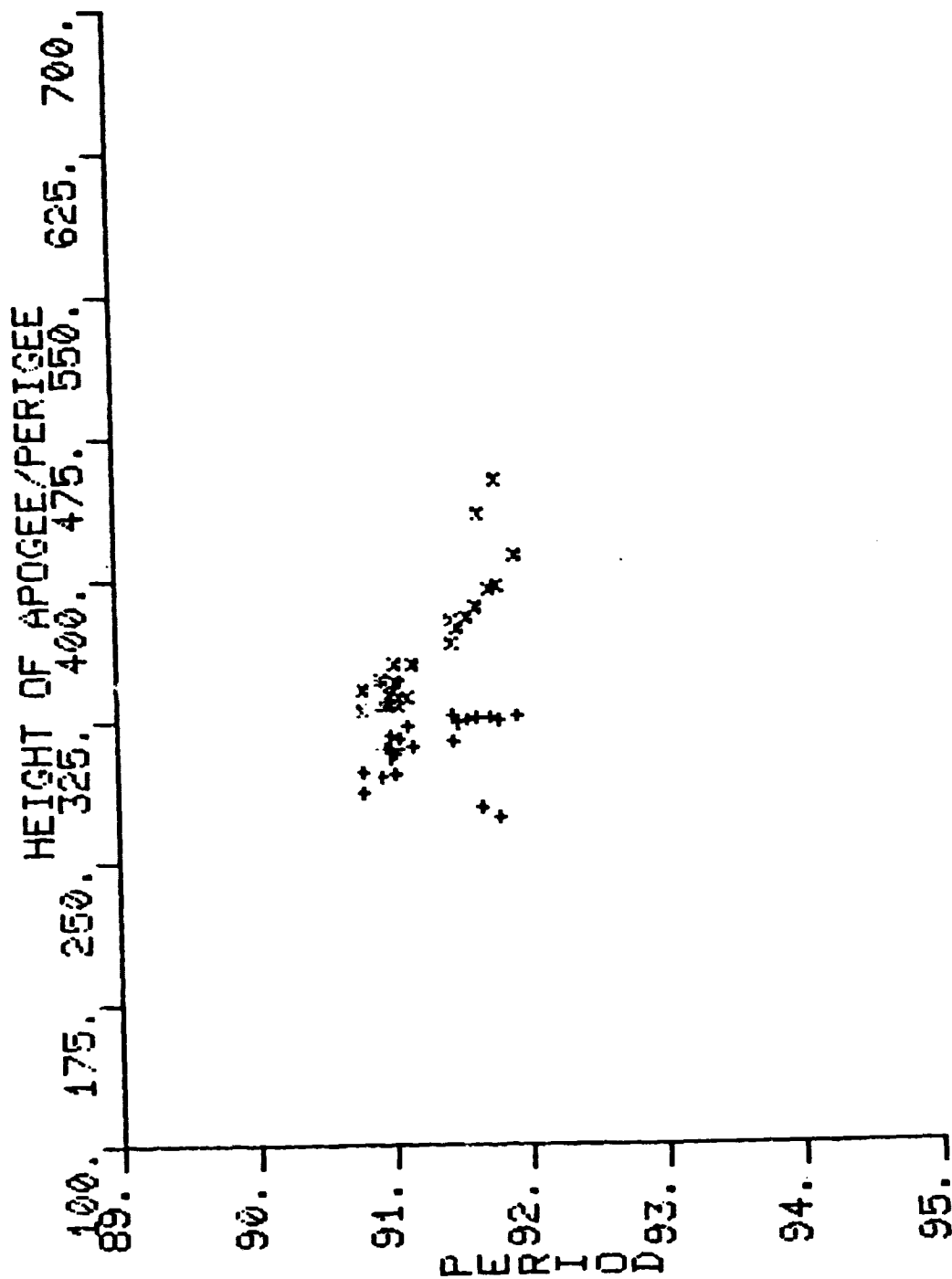
TRUE ANOMALY: 247°

COMMENTS:

- Orbit data as of 16 Dec 1983
- Total count of pieces by sensors was approximately 140.
- Member of Cosmos 699 class.

CAUSE: Apparently deliberate fragmentation.

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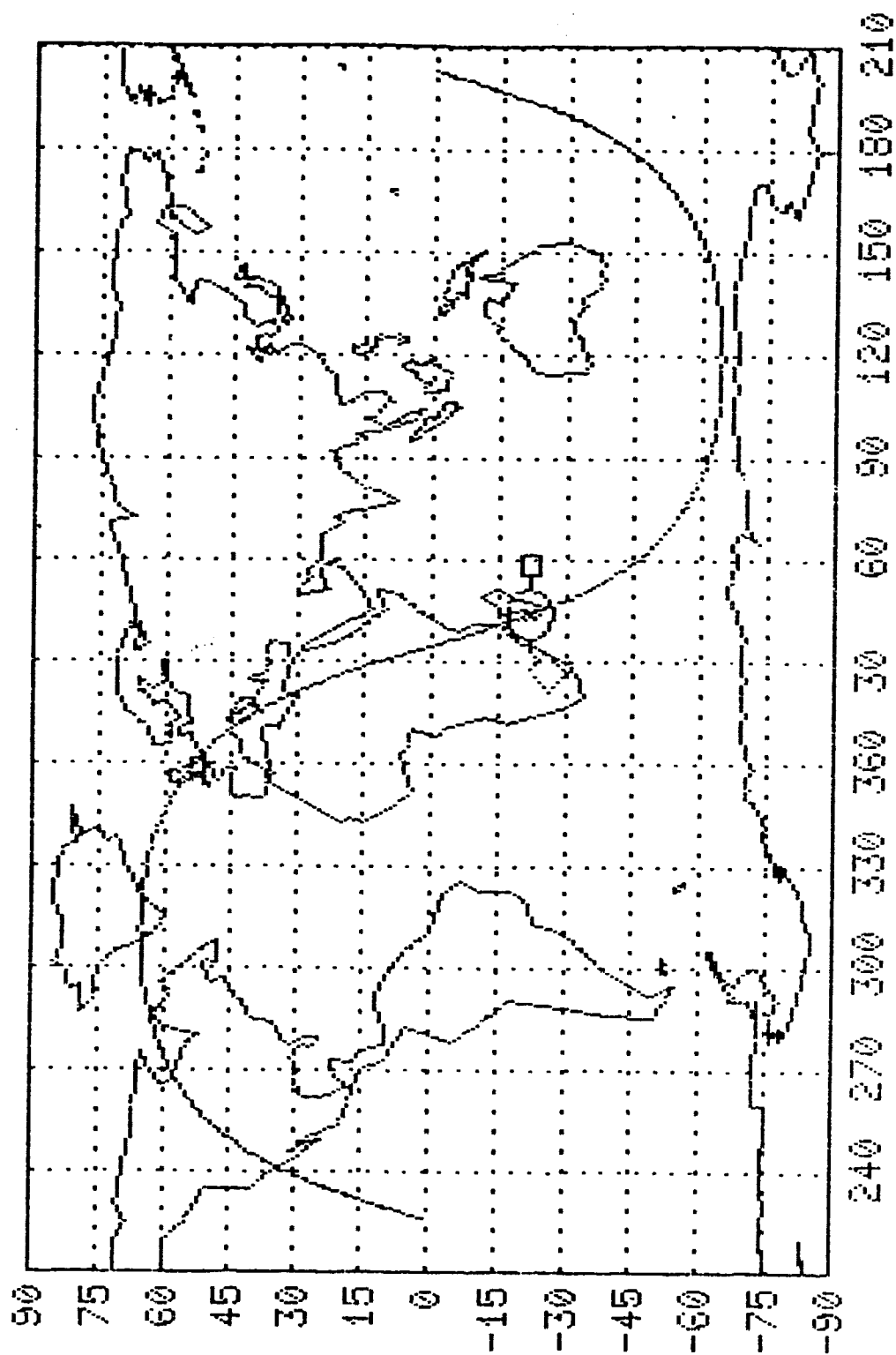


COSMOS 1405

1-308

Cataloged plus 8X,XXX
provisional orbits

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COSMOS 1405

1982-115

COSMOS 1423

13685

LAUNCH DATE: 8.58 Dec 1982

COUNTRY OF ORIGIN: USSR

EVENT DATA: 1. 2.

DATE: 8 Dec 1982 (DAY 342) 9 Dec 1982 (DAY 343)

TIME: 144811.7 GMT 125820.6 GMT

LOCATION: 62 S/302 E 40 S/16 E

ALTITUDE: 402 km 369 km

PIECES CATALOGED (1 JAN 84): 28

PIECES STILL IN ORBIT (1 JAN 84): 22

ORBIT CHARACTERISTICS:

INCLINATION: 62.8° 62.8°

APOGEE: 516 km 516 km

PERIGEE: 400 km 400 km

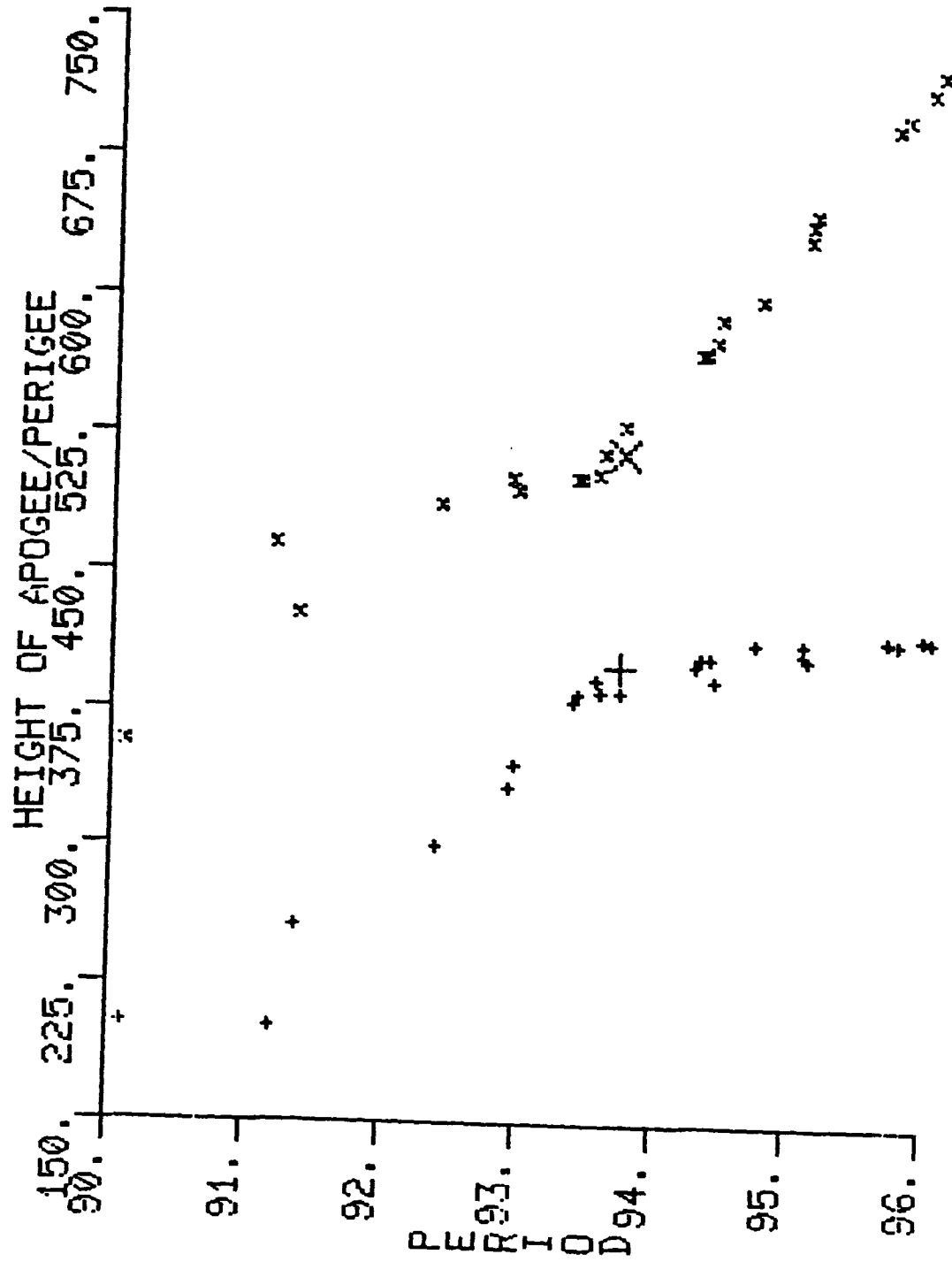
PERIOD: 93.8 min 93.8 min

TRUE ANOMALY: 222° 326°

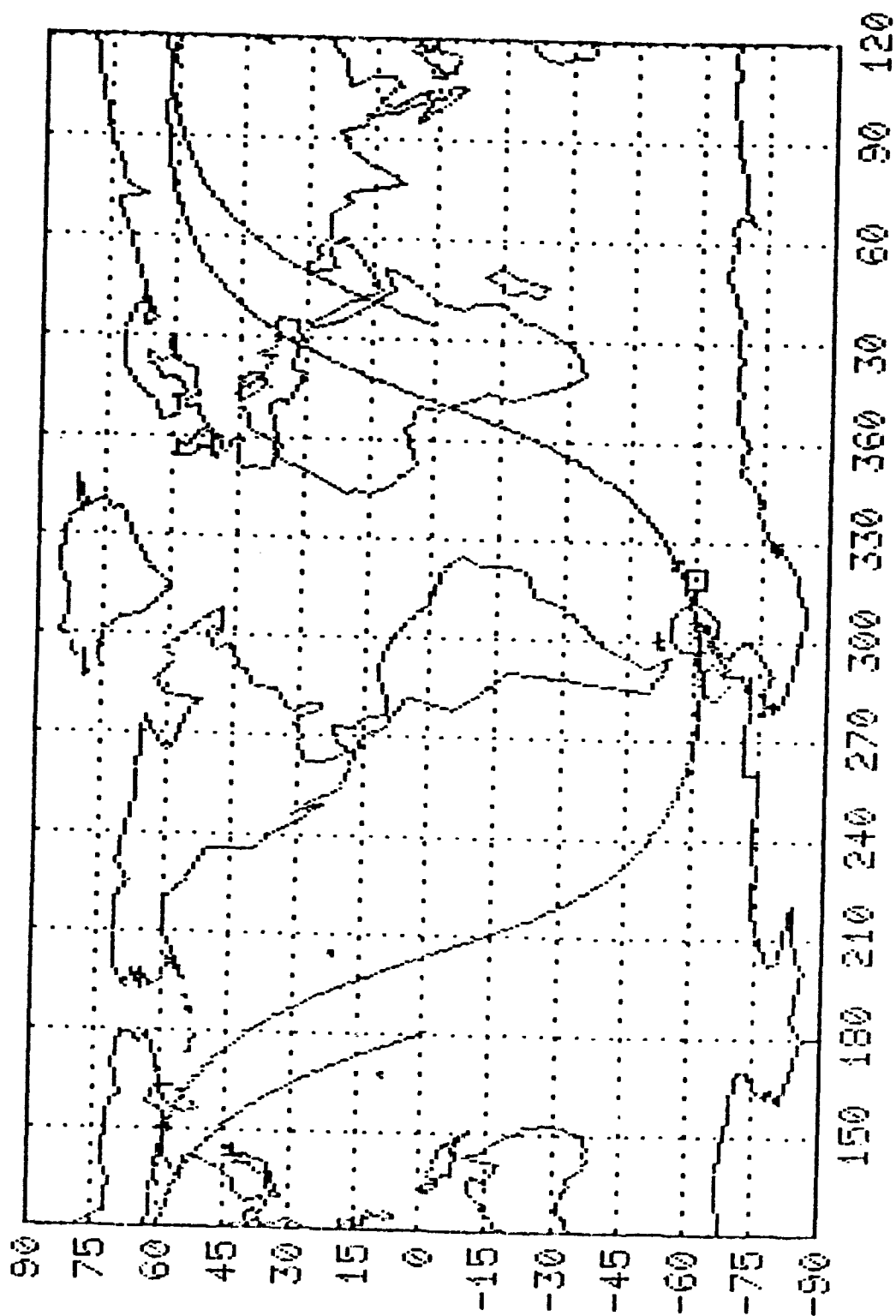
- COMMENTS:**
- General shape was windmill plus cylinder; length 6.2 m; dia. 1.6 m?; weight full, 6050 kg?
 - Failure during attempt to transfer payload to Molniya highly eccentric orbit.
 - 13685 fragmented twice.
 - 17 pieces counted by NORAD sensor for the 2nd fragmentation.

CAUSE: Upper stage engine failure.

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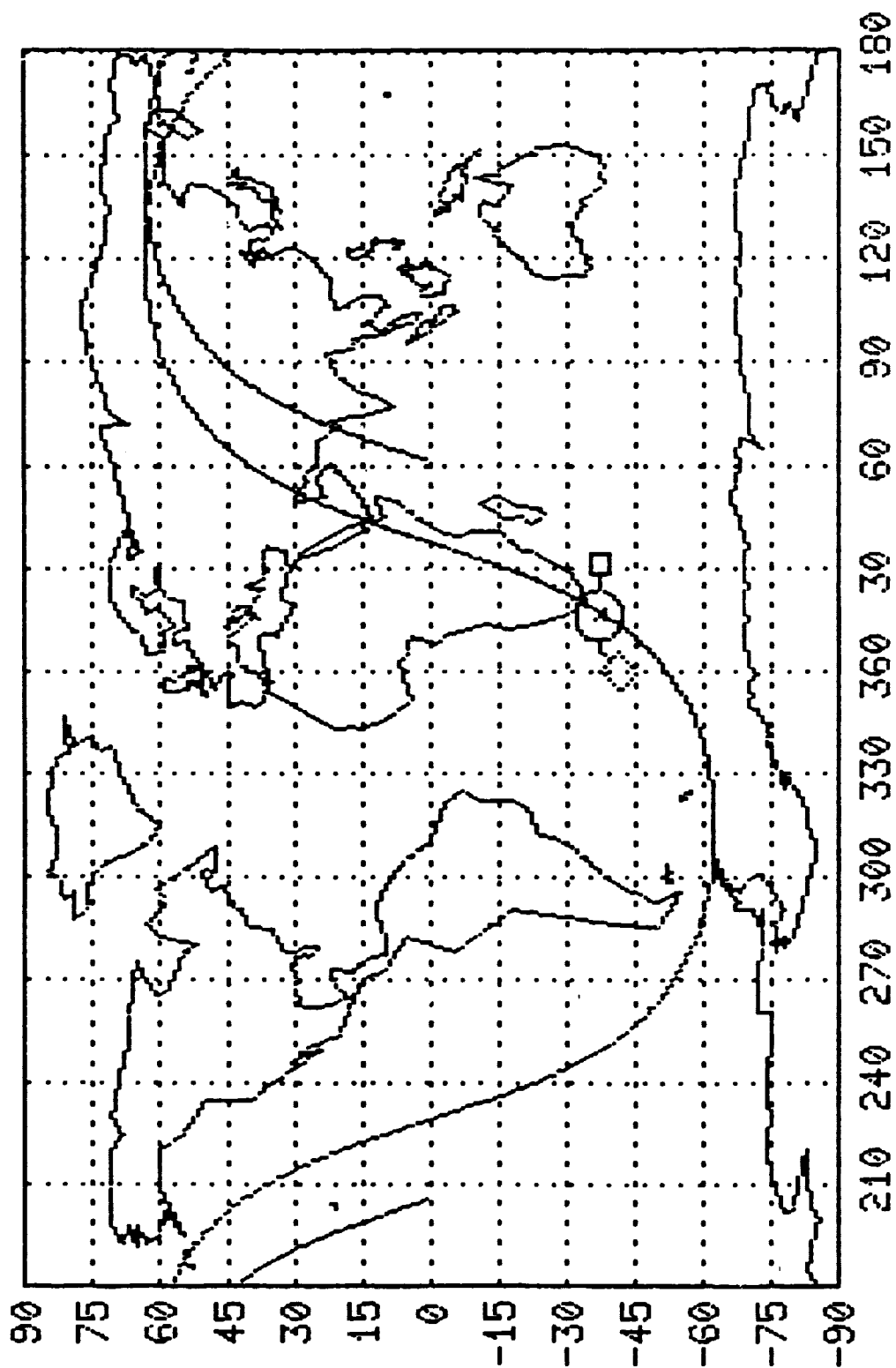
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COSMOS 1423 (1st EVENT)

COMMENTS • Insufficient data was available to resolve the element set information for the two breakups, therefore no orbit distribution plot is provided for the second event.

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COSMOS 1423
(2ND EVENT)

1983-38

COSMOS 1456

14034

LAUNCH DATE: 25.60 Apr 1983

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 12 Aug 1983 (DAY 224)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 4

PIECES STILL IN ORBIT (1 JAN 84): 4

ORBIT CHARACTERISTICS:

INCLINATION: 63.29°

APOGEE: 39631 km

PERIGEE: 729 km

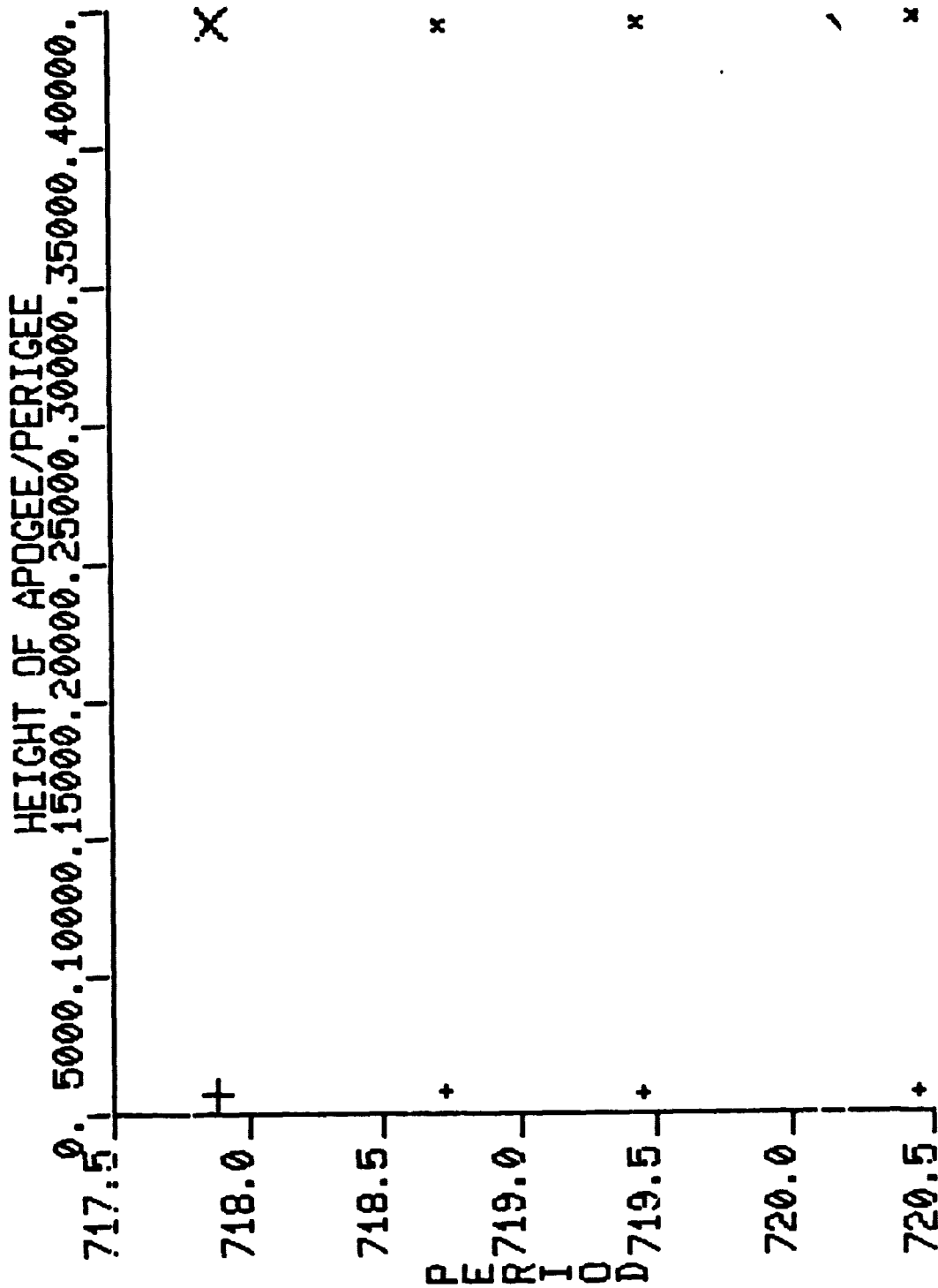
PERIOD: 717.9 min

TRUE ANOMALY:

- COMMENTS:**
- Orbit data derived from element set #49 for satellite 14034.
 - General shape was windmill plus 6 vanes?; length 4.2 m?; dia. 1.6m; weight 1250 kg?
 - Five cataloged pieces in event orbit. One of the 5 is the 2nd rocket of this launch.
 - Ten objects cataloged with this international designator. These include objects in both the low transfer orbit and the high event orbit.

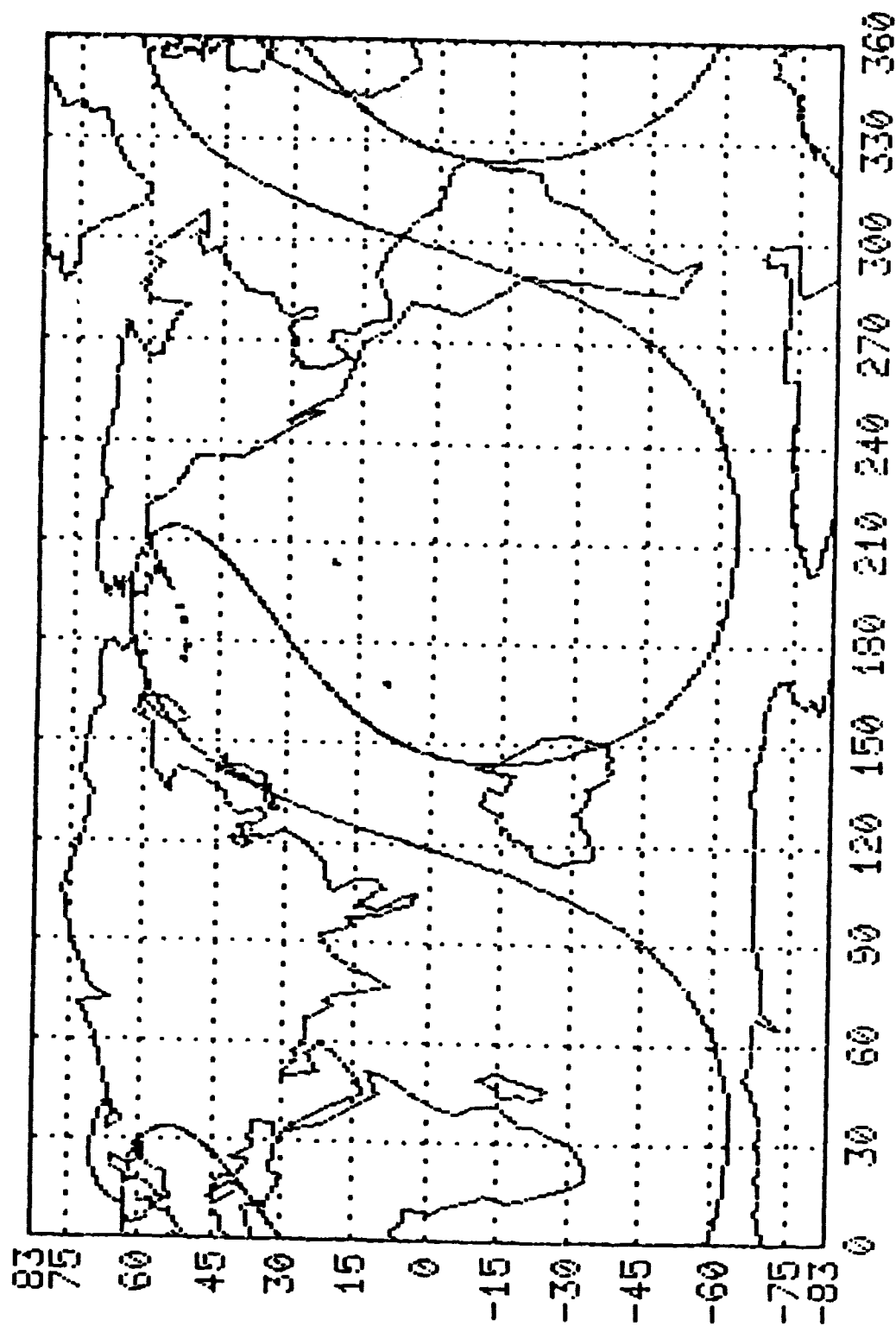
CAUSE: Unknown

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COSMOS 1456

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COSMOS 1456

1983-70

COSMOS 1481

14182

LAUNCH DATE: 8.81 Jul 1983

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 9 Jul? 1983 (DAY 150)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 2

PIECES STILL IN ORBIT (1 JAN 84): 2

ORBIT CHARACTERISTICS:

INCLINATION: 62.92°

APOGEE: 39199 km

PERIGEE: 642 km

PERIOD: 707.4 min

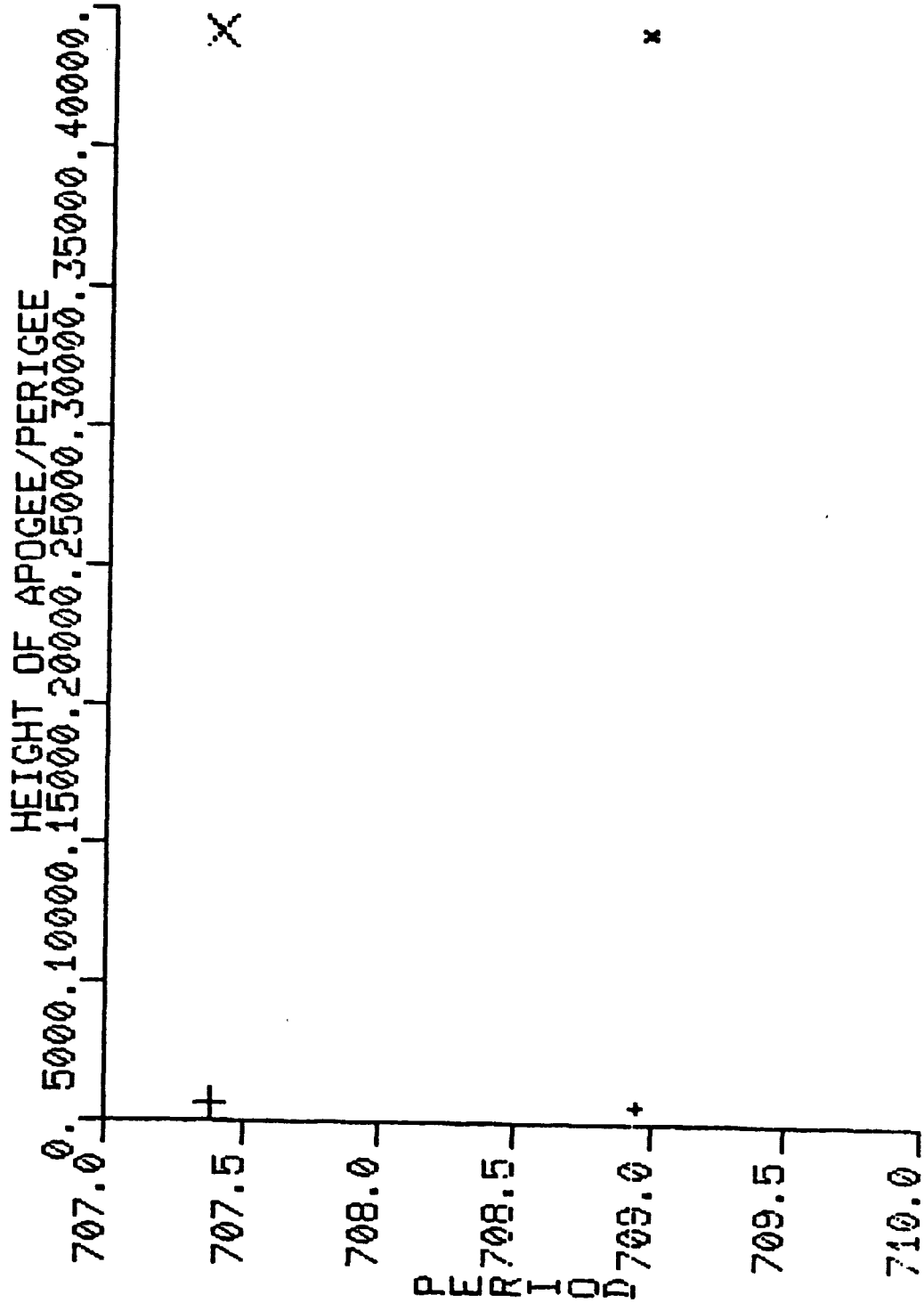
TRUE ANOMALY:

- COMMENTS:**
- Orbit data derived from element set #8 for satellite 14182.
 - General shape was windmill plus 6 vanes?; length 4.2 m?; dia. 1.6 m; weight 1250 kg?
 - Never attained planned orbit.
 - Pieces appeared the day after launch.
 - Two additional 8X,XXX pieces identified.

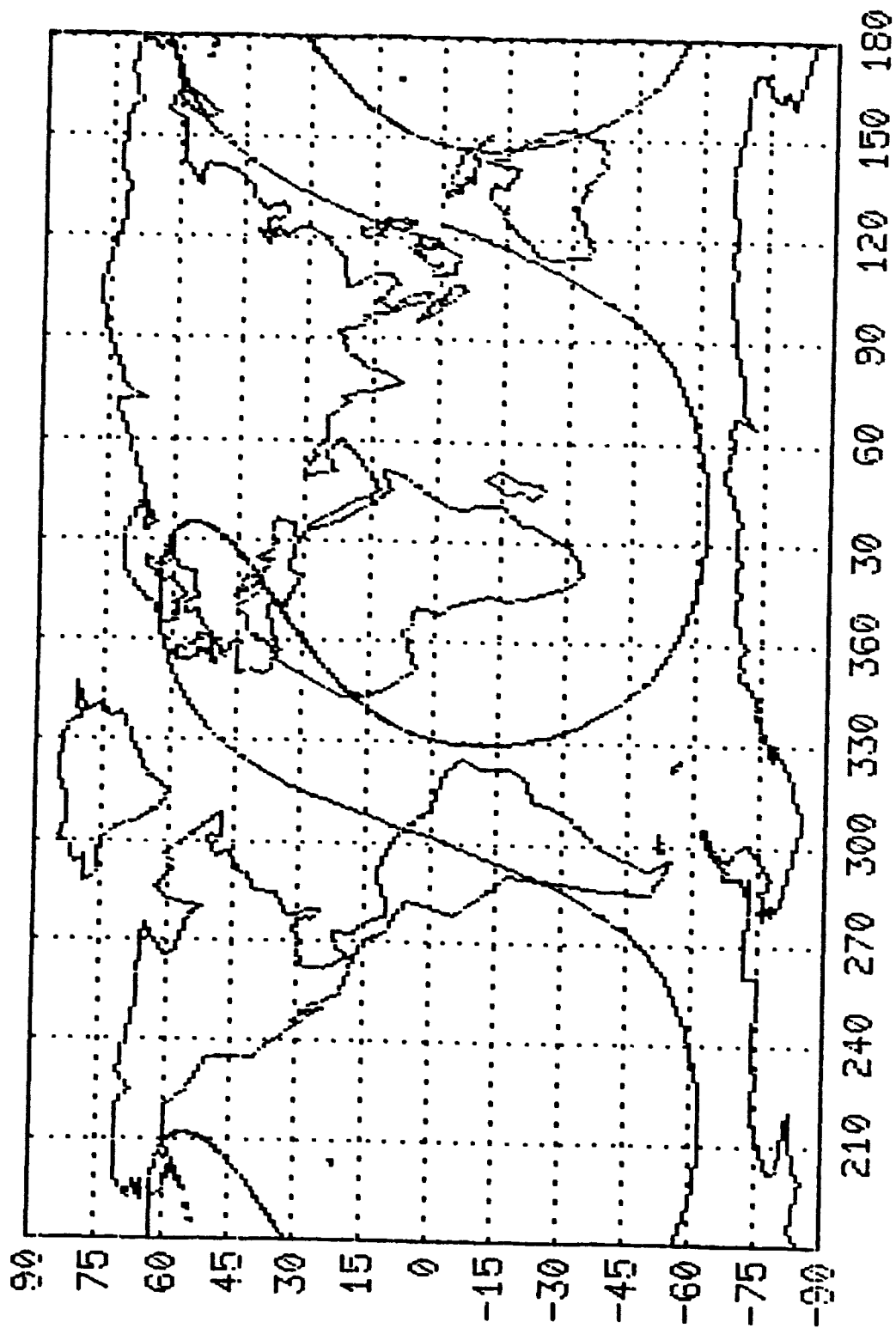
CAUSE: Unknown; possibly propulsion related.

1983-70

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COSMOS 1481

Section II

Satellite Fragmentation Summary Table
Satellite Breakup Status as of 31 Dec 1983

SATELLITE BREAKUP STATUS AS OF 31 DEC 1983

INTERNATIONAL DESIGNATOR	COMMON NAME	NSSC CATALOG NUMBER	LAUNCH DATE	DATE OF EVENT	SATELLITE DEBRIS		PARENT SATELLITE			REMARKS
					CATALOGED	IN ORBIT	INCL (°)	APOGEE (KM)	PERIGEE (KM)	
1961-Omicron	TRANSIT 4A	119	29 Jun	29 Jun	261	152	66.8	998	880	Able Star rocket
1962-B Iota	SPUTNIK-29	443	24 Oct	29 Oct	23	0	64.1	261	202	Payload
1963-47	Atlas Centaur 2	694	27 Nov	27 Nov	14	12	29.9	1735	502	More debris cataloged with 65-82. Rocket
1964-26	Transit 9 (OPS 4412)	809?	4 Jun	Jan-Feb 66	11	10	90.5	935	848	309 most likely parent; some fragments cataloged with other launches
1964-70	COSMOS 50	919	28 Oct	5 Nov	95	0	51.2	233	188	Payload
1965-12	COSMOS 57	1093	22 Feb	22 Feb	166	0	64.8	708	159	Voskhod test flight
1965-20	COSMOS 61-63	1270	15 Mar	15 Mar	147	26	56.0	1827	260	Rocket
1965-82	Titan 3C-4	1640	15 Oct	27 Jul 66	464	163	32.6	791	708	Titan 3C-4 Transtage fragmented
1965-88	COSMOS 95	1706	4 Nov	Mid Nov 65	21	0	48.4	521	211	Payload?
1966-12	Bluebell 2 (OPS 3031)	2015	15 Feb	15 Feb	37	0	96.5	268	147	Inflated sphere
1966-46	ATDA	2188	1 Jun	Jun	50	0	28.8	300	281	Atlas rocket
1966-56	Pageos 1	2253	24 Jun	12 Jul 75 20 Jan 76 Jun 78	12 63	13	85.3 85.1 84.6	5169 5424 5750	3201 2934 2629	Balloon
1966-59	AS-203	2289	5 Jul	5 Jul	33	0	31.9	214	185	Saturn rocket
1966-88	USSR/Unk. 1	2437	17 Sep	17 Sep	54	0	49.6	792	138	Alleged FOBS test
1966-101	USSR/Unk. 2	2536	2 Nov	2 Nov	40	0	49.7	651	188	Alleged FOBS test
1967-01	INTELSAT 2-F2	2643	11 Jan	Early 1971?	23	4	28.7	589	253	Rocket; data indicates debris cataloged with this launch probably originated from another geosync flight.

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SATELLITE BREAKUP STATUS AS OF 31 DEC 1983

INTERNATIONAL DESIGNATOR	COMMON NAME	NSSC CATALOG NUMBER	LAUNCH DATE	DATE OF EVENT	SATELLITE DEBRIS		PARENT SATELLITE			REMARKS
					CATALOGED	IN ORBIT	INCL (°)	APOGEE (KM)	PERIGEE (KM)	
1968-90	COSMOS 248	3503	19 Oct	1 Nov	4	0	62.2	543	473	Alleged ASAT target
1968-91	COSMOS 249	3504	20 Oct	20 Oct	91	55	62.3	2159	496	Alleged ASAT
1968-97	COSMOS 252	3530	1 Nov	1 Nov	122	55	62.3	2139	534	Alleged ASAT
1969-29	Meteor 1	3836	26 Mar	28 Mar	36	2	81.1	851	462	Rocket
1969-64	INTELSAT 3-F5	4052	26 Jul	26 Jul	25	4	30.3	5445	271	Rocket. 4 objects not from 69-64
1969-82	Ops 7613	4132	30 Sep	4 Oct	241	123	70.0	940	907	Payload
1970-25	Nimbus 4	4367	8 Apr	17 Oct	330	282	99.8	1094	1051	Agna D Rocket
1970-89	COSMOS 374	4594	23 Oct	23 Oct	92	44	62.9	2132	529	Alleged ASAT
1970-91	COSMOS 375	4598	30 Oct	30 Oct	41	31	62.8	2186	464	Alleged ASAT
1971-15	COSMOS 397	4964	25 Feb	25 Feb	88	73	65.8	2200	575	Alleged ASAT
1971-106	COSMOS 462	5646	3 Dec	3 Dec	27	0	65.9	1654	231	Alleged ASAT
1972-38	Landsat 1	6127	23 Jul	22 May 75	218	88	98.3	909	633	Delta second stage
1973-17	Salyut 2	6399	3 Apr	3 Apr	25	0	51.5	244	195	Rocket
1973-21	COSMOS 554	6432	19 Apr	6 May	196	0	72.8	350	168	Payload
1973-86	NOAA 3	6921	6 Nov	28 Dec	180	168	102.0	1513	1504	Delta second stage
1974-74	COSMOS 686	7448	26 Sep	26 Sep	19	0	70.9	456	259	Rocket
1974-89	NOAA 4	7532	15 Nov	20 Aug 75	132	124	101.7	1460	1445	Delta second stage
1974-103	COSMOS 699	7587	24 Dec	17 Apr 75 2 Aug 75	50	0	65.0 65.1	444 442	424 414	Two fragmentations one revolution apart

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SATELLITE BREAKUP STATUS AS OF 31 DEC 1983

INTERNATIONAL DESIGNATOR	LAUNCH	COMMON NAME	NSSC CATALOG NUMBER	LAUNCH DATE	DATE OF EVENT	SATELLITE DEBRIS		PARENT SATELLITE			REMARKS
						CATALOGED	IN ORBIT	INCL (°)	APOGEE (KM)	PERIGEE (KM)	
1975-04		Landsat 2	7616	22 Jan	9 Feb 76 } 19 Jun 76 }	197	54	97.8 97.8	915 912	741 742	Delta second stage; small fragmentation. Large fragmentation
1975-27		GEOS 3	7735	9 Apr	12 Mar 78	5	3	115.0	844	837	Delta second stage
1975-80		COSMOS 758	8191	5 Sep	6 Sep	77	0	67.1	324	173	Payload
1975-102		COSMOS 777	8416	29 Oct	26 Jan 76	62	0	65.0	442	430	Payload; two events one revolution apart
1976-63		COSMOS 838	8932	2 Jul	17 May 77	40	0	65.0	444	415	Payload
1976-67		COSMOS 839	9011	8 Jul	29 Sep 77	53	52	65.9	2100	981	Alleged ASAT target
1976-72		COSMOS 844	9046	22 Jul	25 Jul	248	0	67.1	353	172	Debris cataloged but no elements. Payload
1976-77		NOAA 5	9063	29 Jul	24 Dec 77	130	129	102.0	1521	1506	Delta second stage
1976-105		COSMOS 862	9495	22 Oct	15 Mar 77	11*	11	63.1	39644	1352	Payload
1976-120		COSMOS 880	9601	9 Dec	27 Nov 78	50	13	65.8	621	551	Alleged ASAT target
1976-126		COSMOS 886	9634	27 Dec	27 Dec	57	51	65.8	2297	595	Alleged ASAT target
1977-27		COSMOS 903	9911	11 Apr	8 Jun 78	2*	2	63.1	39035	1323	Payload
1977-47		COSMOS 917	10059	16 Jun	30 Mar 79	1*	1	62.9	38723	1643	Payload
1977-65		GMS (Himavari)	10144	14 Jul	14 Jul	147	93	29.0	2027	536	Delta second stage
1977-68		COSMOS 931	10150	20 Jul	24 Oct	4*	2	62.9	39667	682	Payload
1977-121		COSMOS 970	10531	21 Dec	21 Dec	54	54	65.8	1139	946	Alleged ASAT
1978-26		Landsat 3	10704	5 Mar	27 Jan 81	172	155	98.9	912	903	Delta second stage
1978-83		COSMOS 1030	11015	6 Sep	10 Oct	4*	3	63.0	39760	666	Payload

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SATELLITE BREAKUP STATUS AS OF 31 DEC 1983

INTERNATIONAL DESIGNATOR	COMMON NAME	NSSC CATALOG NUMBER	LAUNCH DATE	DATE OF EVENT	SATELLITE DEBRIS		PARENT SATELLITE			REMARKS
					CATALOGED	IN ORBIT	INCL (°)	APOCEE (KM)	PERIGEE (KM)	
1979-33	COSMOS 1094	11333	18 Apr	17 Sep	2	0	65.0	405	382	Payload; 23 fragments decayed before being cataloged
1979-58	COSMOS 1109	11417	27 Jun	Sep ?	4*	4	62.9	39679	712	Payload
1979-77	COSMOS 1124	11509	28 Aug	9 Sep	5*	5	62.9	39754	574	Payload
1979-104	ARIANE VI	11659	24 Dec	Early 1980	1*	0	17.6	35839	189	Rocket; appears to have fragmented shortly after launch; at least 25 objects have been tracked
1980-21	COSMOS 1167	11729	14 Mar	15 Jul 81	12	0	65.3	450	357	Payload
1980-30	COSMOS 1174	11765	18 Apr	18 Apr	39	22	65.8	1025	362	Alleged ASAT
1980-57	COSMOS 1191	11871	2 Jul	14 May 81	2*	2	62.6	39283	1083	Payload
1980-89	COSMOS 1220	12054	4 Nov	20 Jun 82 25 Aug 82	63	57	65.0 65.0	883 873	571 580	Payload Payload
1981-16	COSMOS 1247	12303	19 Feb	20 Oct	4*	4	63.0	39401	362	Payload
1981-24	COSMOS 1258	12337	14 Mar	14 Mar	1	0	65.8	1024	301	Alleged ASAT. 12-18 pieces detected reentering
1981-28	COSMOS 1260	12364	20 Mar	8 May 82 10 Aug 82	65	37	65.0 65.0	720 753	422 447	Payload Fragment
1981-31	COSMOS 1261	12376	31 Mar	12 May	4*	4	63.0	39743	649	Payload
1981-53	COSMOS 1275	12504	4 Jun	24 Jul	226	223	82.9	1014	961	Payload
1981-71	COSMOS 1285	12627	4 Aug	21 Nov	3*	3	63.0	40109	721	Payload
1981-72	COSMOS 1286	12631	4 Aug	29 Sep 82	2	0	65.2	327	304	Payload; Est. 30 pieces decayed before they could be cataloged
1981-88	COSMOS 1305	13818	11 Sep	11 Sep	2*	2	62.8	13864	626	Rocket malfunction, other pieces detected, but not cataloged

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SATELLITE BREAKUP STATUS AS OF 31 DEC 1983

LAUNCH

INTERNATIONAL
DESIGNATOR

COSMOS
NAME

NSSC
CATALOG
NUMBER

LAUNCH
DATE

DATE OF
EVENT

SATELLITE DEBRIS

CATALOGED

IN ORBIT

PARENT SATELLITE

INCL
(°)

APOGEE
(KM)

PERIGEE
(KM)

REMARKS

1981-89	COSMOS 1306	12828	14 Sep	12 Jul 82	6	1	64.9	407	380	Payload; 27 pieces counted
		13369		18 Sep 82	1	0	64.9	372	369	Fragment; from 1st event
1982-38	COSMOS 1355	13150	29 Apr	8 Aug 83	22	3	65.1	395	362	Payload. (2 more events, 1984)
1982-88	COSMOS 1405	13508	4 Sep	20 Dec 83	5	5	65.0	342	315	Payload, Est. 30 pieces detected
1982-115	COSMOS 1423	13685	8 Dec	8 Dec	28	22	62.8	516	400	Payload fragmented twice
				9 Dec			62.8	516	400	17 pieces counted on 2nd event
1983-38	COSMOS 1456	14034	25 Apr	12 Aug	9*	5	63.3	39631	729	Payload
1983-70	COSMOS 1481	14182	8 Jul	9 Jul	1*	1	62.9	39199	642	Payload
Total					5250	2497				

Total number of all cataloged satellites in orbit 1 Jan 84: 5064

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*Note: Fragments in highly elliptical, "deep-space" orbits are extremely difficult to track. Consequently, the number of pieces of debris cataloged with these orbits is very small and probably not representative of the true population.

Update: Cosmos 1317 fragmented between 25 & 28 January 1984, six pieces detected. Cosmos 1355 experienced two other fragmentation events; one on 1 February 1984 and one on 21 February 1984.

Section III

Other Anomalous Event Summary Table

The space events in this section can not be classed as forceful fragmentations. However, small amounts of debris listed under "NSSC Debris Number" have been left in space due to unplanned events and the causes for most are unknown. Of particular interest are those old US payloads that spawn pieces at irregular intervals.

ANOMALOUS EVENTS

INTERNATIONAL DESIGNATOR	LAUNCH	COMMON NAME	NSSC CATALOG NUMBER	LAUNCH DATE	PARENT SATELLITE ORBIT AT DATE OF EVENT			EVENT		REMARKS
					INCL (°)	APOGEE (KM)	PERIGEE (KM)	DATE	NSSC DEBRIS NUMBER	
1964-014		WESTFORD NEEDLES	574	9 May	87.3	3694	3597	9 May 63	See	101 debris pieces cataloged, deployed as part of launch sequence but not expected
1964-26		OPS 4412	801	4 Jun	90.5	847	930	19 Dec 80	12142	Decayed 25 Oct 81
1965-16		GREB-6	1271	9 Mar	90.5	844	923	2 Jul 82	13360	
1965-27		SNAPSHOT	1314	3 Apr	70.1	1318	1273	26 Nov 80	12099	
					90.3	1319	1272	Late Nov 79	11631	Payload contains SNAP nuclear power supply
					90.3	1316	1272	6 Dec 80	12102	
					90.3	1319	1272	23 Aug 81	13131	
					90.3	1320	1271	19 Mar 83	14047	
								19 Mar 83	14048	
								19 Mar 83	14049	
					90.3	1320	1271	Late Aug 83	14715	
								Late Aug 83	14716	
								Late Aug 83	85577*	
								Late Aug 83	85632*	
1965-48		# TRANSIT 5B-6	1420	24 Jun	90.3	1320	1271	Late Nov 83	14717	
					89.9	1135	1025	22 Aug 80	11952	
					89.9	1135	1025	24 Aug 80	11953	
					89.9	1132	1021	Jun 81	12516	
								Jun 81	12582	
1966-05		OPS 1953	1952	28 Jan	89.8	1205	857	13 Aug 80	11990	Decayed 11 Jan 83
					89.8	1202	860	17 Sep 80	11991	
					89.7	1154	820	Jul 83	14226	Spawned from debris 11991

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ANOMALOUS EVENTS

INTERNATIONAL DESIGNATOR	COMMON NAME	NSSC CATALOG NUMBER	LAUNCH DATE	PARENT SATELLITE ORBIT AT DATE OF EVENT			EVENT		REMARKS
				INCL (°)	APOGEE (KM)	PERIGEE (KM)	DATE	NSSC DEBRIS NUMBER	
1966-24	OPS 1117	2119	26 Mar	89.9	1114	888	5 Jul 81	12856	
1967-92	OPS 4947	2965	25 Sep	89.3	1110	1036	Late Apr 81	12554	
							Late Apr 81	12555	
1974-89	Debris (NOAA)	8138	15 Nov	101.6	1323	1135	17 Sep 81	13130	Radar cross section of parent .3m ² ; 6 pieces noted; Only one cataloged
1978-64	SEASAT 1	10967	27 Jun	108.0	782	780	18 Jul 83	14244	Noticed on 18 Jul 83. Separation rate 16-17 seconds per day
1978-98	CAMEO	11081	24 Oct	99.3	954	937	6 May 81	88503**	The two pieces came off 11081 5 hours apart
							6 May 81	88504**	Decay rate extremely high on both pieces
1984-11	WESTAR 6	14688	3 Feb	27.7	457	303	3 Feb 84	14698	Debris caused by PAM engine failure
								14765	
								thru	
								14773	

*Satellites pending cataloging as of 1 Jan 84.
 **Satellites decayed before formally cataloged.
 †Previously designated "OSCAR 4"

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